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Electrical World

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Electrical World

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New York, Saturday, June 24, 1922

Volume 79 *Number* 25

Why the Vehicle Waits

THE other day there appeared in the leading New York newspapers a full-page advertisement by an electric vehicle manufacturer. It was well displayed, well illustrated, full of interesting facts, convincing in argument and strong in selling appeal. It offered one of the best-known trucks at a newly reduced price, with an easy-payment plan, quantity discounts and a money-back guarantee.

Every electrical man who read it was surprised. For electrical men have got into the habit of not taking the electric vehicle very seriously.

YET this same electric vehicle offers one of the greatest economic benefits which electricity has ever brought to industry. It promises one of the most productive loads the central station has ever known. It will some day provide a volume of business that will probably rival any other branch of our great industry. And this has been apparent to many minds for many years. But it has waited on development by the vehicle manufacturer and acceptance by the central station.

The central-station man has stalled because he tried to use the earliest vehicles unintelligently for every class of service and, being disappointed, turned against them. The vehicle manufacturers have resented this lack of sympathy and vision and been out of patience with the central station. They have also wrangled among themselves and wasted time and energy.

As a result the evolution of the electric vehicle has been lamentably delayed. But it has not stood still, because it embodies fundamental advantages and principles that are economically sound and no combination of prejudices could permanently block it.

ELECTRICAL men can no longer afford to ignore the electric vehicle. Vehicle manufacturers can no longer afford to weaken their influence by friction between the road-truck and industrial-truck factions, by antagonistic competition between individuals, and by disregard of the vital need of selling the idea to the central station.

To the public all kinds of trucks are electric vehicles, and people will inevitably continue to go to the central-station man to ask advice. And as long as the battery must be charged with electric power, it will remain in the popular mind an electrical appliance.

The electric vehicle will never come into its own until the central station believes in it, uses it, supports it and co-operates in the establishing of adequate local servicing facilities. This already-possible load of inestimable value both in profit and good will and this great undeveloped branch of the electrical industry are held back waiting for the vehicle men and the central-station men to get together.

Rudolph Frederick Schuchardt

An outstanding figure in the electric power and light industry and the new chairman of the N. E. L. A. Technical Section.

FEW engineers can do many things well, and still fewer can be counted upon at all times when the electrical industry calls upon them for assistance. R. F. Schuchardt is one of the most versatile men in the industry and has attained an outstanding technical position as electrical engineer for the Commonwealth Edison Company. In addition, he has been a very influential factor in the upbuilding of all phases of the electrical business through his active participation in the work of the national and local organizations. His versatility is indicated by the fact that, on the one hand, he won the Chanute medal of the Western Society of Engineers for an able paper on "The Rotary-Converter Substation" and was responsible for the electrical features of the Northwest and Calumet stations of his company, while, on the other hand, he has written a play which was produced by the students of the University of Wisconsin, his alma mater, and a booklet entitled "Panama and the Isthmian Canal." In the civic affairs of Chicago Mr. Schuchardt has taken an active interest and has held responsible positions. He was president of the Lake View Civic League for eleven years, is now a member of a committee studying the electrification problems of Chicago, and is active on the ways and means committee of the Chicago Association of Commerce.

He was born in Milwaukee, Wis., Dec. 14, 1875, and received the degree of electrical engineer from the University of Wisconsin in 1897. After graduation he was connected with the Janesville Electric Light & Power Company and then was an engineer with Mysenberg & Badt of Chicago. Entering the employ of the Commonwealth Edison Company in 1898 as a substation operator, he rose rapidly in the organization and became chief electrical engineer in 1909. While with this "big policy" company he has been very active in the development of all phases of its business. His work in laying out the new stations and in solving the problems in protection and distribution has furnished the material for many articles in the technical press and has given him the experience and knowledge that have made his services so valuable to the Technical Section of the National Electric Light Association. The operating system of the company, the school for the education of the employees and the Edison Round Table are largely the result of his activities. In addition he has served and is serving on some of the most important committees of the A. I. E. E. and the N. E. L. A., and is a past-president of the Chicago Section of the Illuminating Engineering Society.

The titles of some of the papers that Mr. Schuchardt has contributed to the A. I. E. E. are "The Use of Power-Limiting Reactors with Large Turbo-Alternators," "The Protective Equipment on the System of the Commonwealth Edison Company" and "The Use of Reactors on Large Central-Station Systems." He is a fellow of the Institute and chairman of the power-stations committee. As a member he is active in the I. E. S., the Western Society of Engineers, the Society for the Promotion of Engineering Education, and the Institution of Electrical Engineers of Great Britain. Director of the City Club of Chicago and a member in the Chicago Engineers' Club and the University Club of Chicago, he still finds time to act as president of the University of Wisconsin Club of Chicago.

Mr. Schuchardt's breadth of mind, industry and vision will as never before be devoted to developing the industry during the coming year.

Editorial Comment

Electrical World, June 24, 1922

Volume 79 Number 25

Government Control Means Higher Taxes

A VIVID picture of how government operation of public utilities paralyzes the taxpayers was set forth in a recent statement by the Real Estate Board of New York. The real-estate men view with misgiving the "growing tendency," because municipal operation means tax exemption for the utility, and if no new revenues are discovered, "the old standby," real property, must take on the extra burden.

In the United States there are privately owned electric power and street railway utilities valued at something like eleven billion dollars. There are municipally owned utilities of the same kind estimated to be worth two billion dollars. If all public utilities are to be acquired and publicly owned, it will mean new bond issues of eleven billion dollars, which added to the seventeen billion dollars of tax-exempt securities already outstanding would make a total of twenty-eight billion dollars, or close to one-fifth of all our taxable national wealth, relieved from the burden of taxation.

In Manhattan Borough, New York City, it is said, only 2 per cent of the heads of families own their own homes. To 98 per cent of the householders, therefore, the question of whether or not a city-owned public utility returns a profit on its operation is apt to be of less pressing interest than obtaining lower rates for service or than more extensive service. As a matter of fact, the present annual loss of ten million dollars to the city on money invested in subways on which there is no interest return receives very little attention and small adverse criticism, although it adds ten points to the tax rate.

Many excellently sounding reasons are advanced why there should be public operation of public utilities, but it does not necessarily follow that public operation is profitable or desirable. Virtual public ownership can best be obtained by the natural process of selling the securities of the utility to the people of the community. The interests of the people are then safeguarded because they own the utility. And, because professional operation has always proved less costly than political operation, the people who own the company through security holding always prefer to operate that way.

A Basis for More Intelligent Selection of Insulating Oils

CONCLUSIONS from real research on insulating oils for transformers and circuit breakers are presented in this issue by C. J. Rodman, who points out that erroneous conceptions have been held in the past regarding the behavior of such oils. One correction which he emphasizes is that mineral-oil vapor is not spontaneously explosive and that even when subjected to an arc it has a narrow explosive range, dependent on the amount of air mixed with it. Owing to the greater hazard with circuit breakers, due to the violent agitation of the oil during the rupture of the current, Mr. Rodman advocates the omission of air vents on the tanks of such apparatus and suggests that inert gases might be used to fill the space required over the oil to allow for expansion. In view of the research on which these suggestions are based, they should receive serious consideration. However, it may be pointed out that the mufflers now used on some circuit breakers virtually preclude the possibility of oil explosion following current rupture.

Sludging of oil has been experienced so extensively in both transformers and circuit breakers that the author's explanation of the three most common causes of sludge formation should be a most welcome help in eliminating this operating trouble. Evidently the principal remedial steps in both cases will be to design the containing tank so that the oil will not be brought in contact with air, to prevent corona discharge, to avoid hot spots and to use materials which will not react with the oil selected. As for the oil itself, or a substitute therefor, it is obvious that the ideal dielectric for transformers and circuit breakers would be a non-inflammable fluid of high dielectric strength, and it should also be resistant to chemical action and should not act as a solvent for the materials immersed in the oil. An additional requirement for transformer oil, of course, is that it should possess sufficient fluidity to insure adequate cooling. Certain of the saturated mineral oils best fill these requirements, but much room for improvement still remains.

Export Trade and Foreign Standards

THERE is an interesting problem before the electrical manufacturers of America in the question whether they should imitate the designs and standards of foreign countries or insist upon selling their own standards or nothing. Customers abroad have long been accustomed to types and styles which differ widely from those which we use in this country. Manufacturers here are equipped to make their own goods in their own way and can naturally produce most profitably by adhering to their established standards. But the purpose in export business is to sell goods to foreign peoples, and there are other considerations to be counted in. For instance:

Many of our wiring devices do not appeal to foreign buyers because their custom has been to use wall switches and few pull chains or key sockets, and they prefer the tumble switch to the snap switch.

Many of our devices are too costly for the foreign market because regulations are less stringent there and more economical materials and fittings may be used. In Europe they use iron conduit with a wall much thinner than ours, as well as Bergman tubing, which is made of insulating paper impregnated with compound and surrounded by a brass shell. This tubing is installed ex-

posed and has been long in use with apparent satisfaction. At the same time bayonet-type sockets, lamp bases and plugs are in general use. Wire is often sold in millimeter sections and of certain lengths. And there are naturally other local trade conditions.

To attempt to force our more rugged, supersafe devices and materials and our different standards upon the foreign market often places us at a serious disadvantage. The question is, however, just how far the American manufacturers want to go in the production of special export types and styles, for, of course, one of the reasons why export business is so profitable is that it provides a market for surplus stock and surplus capacity and a diversity of demand that fills up the valleys of the local seasonal business.

During the war we were able to force our standards upon the foreigner to a degree not possible today. It would be ideal if all the world would accept our ways, but it will not. And we must not forget that the success of the German in export trade in the days before the war was due in no small measure to his readiness to adapt himself to the habits and tastes of his customer and make for foreign markets what the foreign people want to buy. It is an element in our export opportunity that must not be overlooked

The Muscle Shoals Muddle

INSTEAD of bringing order out of chaos, the various committees of Congress that have had the Muscle Shoals matter under investigation for some time have only added still further to the confusion. The House military committee, for instance, has returned four sets of recommendations. The majority report recommends the acceptance of the Ford proposal except that it would exclude the Gorgas steam plant. One minority report recommends compliance with all the Ford provisions and asserts that excluding the Gorgas steam plant would defeat the entire offer. The second and third minority reports are adverse to the Ford proposal as presented. Thus the House committee proposes three courses to Congress—one, government ownership and operation; another, government ownership and private operation, and a third, making the necessary appropriations for the dams, authorizing the sale of all the plants and properties and the leasing of the power developed, thus freeing the government from further expense for operation and maintenance. The government has expended approximately $106,000,000 on the Muscle Shoals property, which expenditure, though extravagant, was deemed necessary as a war measure. Certainly the House committee is not lacking in humor, since Mr. Ford's offer of $5,000,000 in cash is labeled "a mere bagatelle."

The Senate, as was to be expected, is more definite and constructive in its recommendations. The Norris committee recommends that a sufficient appropriation be made to complete the uncompleted work, thus conserving the large investment already made, after which time due consideration can be given the several offers made for the government property. Of course, the government will never get back any considerable part of the money it has put into the property, and it cannot, or if it can it ought not to, operate the project. We doubt whether, after having committed itself to a definite water-power policy, there is any likelihood of the government tying itself up for one hundred years in a contract with Henry Ford, but the House committee obviously has done nothing to clear up the matter. When all phases of the situation have been canvassed there is no escape from the conclusion that electric public utilities are best equipped to develop water-power resources economically and efficiently and to make the power available to the greatest number of people. That, after all, is the function of government, and no public property should ever be turned over to a private individual—be it Henry Ford or any one else—for his personal benefit and profit.

The Queenston Station—Another Step in the Development of Great Lakes Power

REGARDLESS of how one may view the Hydro-Electric Power Commission of Ontario or what may be thought of some of the outstanding features of its chief station on the Niagara River at Queenston—and we have been among the severest critics—there is much that is commendable in the plant. Passing over the choice of frequency, which we feel is a colossal blunder, and the high cost of the development, we are free to acknowledge the boldness, enterprise and daring shown in much of the electrical work undertaken. In conception no fault can be found with the general plan—it is ideal. It embraces a superpower hydro-electric station, the largest in the world, and a vast network of interconnected lines. This makes for efficiency and, if the costs are carefully watched, ought to result in cheapness of energy as well.

The station at Queenston is remarkable in that it utilizes nearly 94 per cent of the drop between Lake Erie and Lake Ontario, and because of the ideas embodied in the layout and construction to assure high plant efficiency and continuity of operation. With plans for an ultimate rating of 500,000 kw. and involving units of 55,000 hp. and larger, care had to be exercised in the Queenston station to prevent excessive damage from short circuits. The very complete investigation of this subject by engineers of the Hydro-Electric Power Commission is an indication of the thoroughness with which the major problems of design were attacked. One of the most interesting observations was that the star bus, with reactors only between generators, is the most desirable for four or fewer units, whereas the loop bus is preferable where more units are operating in parallel. The design of generators for an overspeed of 185 per cent and the precautions taken to guard against the units dropping out of step and other similar protective measures were all accomplished happily without adding complexity to the system.

Certainly, there is much that is worthy of emulation in the study made of the destructive forces exerted on busbars and the methods of mounting to offset these forces as well as to avoid interphase short circuits. The unusually extensive use of differential relay protection is another feature worthy of comment. Why the high-tension equipment was not mounted on the roof of the station or on the top of the escarpment is a question which engineers might properly ask, but a little thought will show that the engineers of the Hydro-Electric Power Commission made the best selection possible since space was available between the generator room and the side of the gorge, and housing did not add an appreciable expense. An innovation which will commend itself to other plants using vertical units is the practice of building the generator-room floor on the

level of the top of the generator frames, allowing the direct-connected exciters to project above the floor. Such an arrangement facilitates ventilation of the units, provides a convenient location for the auxiliaries, braces the superstructure, and, what is most important from an operating viewpoint, removes obstructions from the generator-room floor. No doubt, operating engineers will also find much to interest them in the arrangement of the busbar structures.

Unlike most municipally or governmentally owned electrical enterprises, a much higher order of engineering skill than usual has been manifested in the work of the Hydro-Electric Power Commission. While it is only just that the engineers responsible for the design should receive all the credit that is due them and which we feel every engineer will gratefully accord them, this, of course, will not cause blindness to the economic questions involved and the larger issues of public policy.

Temperature Control of Transformers Needs Further Investigation

OPERATION of distribution transformers on a temperature basis rather than by the hit-and-miss method of trying to estimate the actual load from a book record of connected load on the consumers' premises is making progress despite the difficulties in the development of methods. That there are distinct advantages seems evident from the data presented in the recent discussion of the report of the overhead-systems committee at Atlantic City. L. L. Elden, in presenting the data on about five hundred transformers in Boston operated with temperature control, said that it had been possible to operate transformers at 175 per cent of rating day after day, and, even with the high summer temperatures, ratings of better than 100 per cent have been maintained. The data presented indicated that much higher average ratings have been maintained than has been possible under the older methods. All of this points to possibilities of better use of existing equipment and possible reduction of investment charges.

There is a decided difference of opinion among authorities as to the way in which temperature should be measured. Some contend for a correction for ambient temperatures. Others contend that the actual temperature inside the transformer, regardless of the outside temperature, is the proper measure. A good deal of difficulty is experienced in getting at the real answer because of the lack of instruments for general use that will reveal what actually happens in the transformer. In recent investigations maximum-reading thermometers, similar to the clinical thermometers used by physicians, seem to be gaining favor because of the ease with which they can be put in different positions in the transformer under observation. But, even with the results of investigations with such thermometers available, different authorities are inclined to disagree as to the best position for the thermometer. In one case it is stated that the instrument should be placed directly over the core in the stream of heated oil rising to the surface from the coils and core. Others claim that the instrument should be worked into the oil ducts, or down into the coils, or against the core.

It seems clearly proved that there is a distinct advantage in temperature control. There is yet an open question as to the most practical means of obtaining the advantage. Further investigation like that in Boston will aid materially in supplying the answer.

Bay State Industries Believe in Central-Station Service

MASSACHUSETTS industries are being electrified along progressive engineering and economic lines, according to the extended analysis of this important subject presented by R. M. Davis on another page of this issue. This analysis, which is the fifteenth in the series of industrial electrical surveys being conducted on a country-wide basis by the McGraw-Hill Company, under the supervision of the editorial departments of the ELECTRICAL WORLD and *Power*, shows very clearly that if the good work already accomplished by electrical engineers continues, it will not be many years before Massachusetts will furnish a superb example of industrial electrification from the standpoint of varied and carefully designed installations.

It is particularly gratifying to observe the extent to which manufacturers are depending upon central-station energy for the operation of their plants. Nearly two-thirds of the inconceivable total of 1,600,000,000 kw.-hr. consumed by Massachusetts industries in 1920 was purchased from central-station systems. The war was an enormous stimulus to the buying of energy, and industry has stuck to its new friend, the electric utility, because the latter has made good year in and year out in efficiency and reliability of service. It is not easy to measure the influence of central-station power engineers upon industrial-plant electrical practice, but it is unquestionably far-reaching. It would be less so were industrial managers, superintendents and engineers less open-minded; but, fortunately for all concerned, there has been and still is a very high grade of co-operation in making electrical applications along the lines of the best modern thought in this immensely important field.

More than half the motors in Massachusetts industries are under 5 hp. in rating, out of a total of some 117,000. This subdivision of driving makes for admirable control of manufacturing processes and waste reduction in power use. The textile industry, as might be expected, is much the largest user of industrial energy, taking about 41 per cent of the total in 1920. Individual motor drives have made mighty strides in this field in the last decade, and so the small motor has come sharply to the front. More than a third of the motors in this state's industries are in textile mills. Other industries, however, are extensively electrified now, and the general use of alternating current is marked, though requirements of variable-speed motor service have retained a relatively large amount of direct-current service in the metal-working industries.

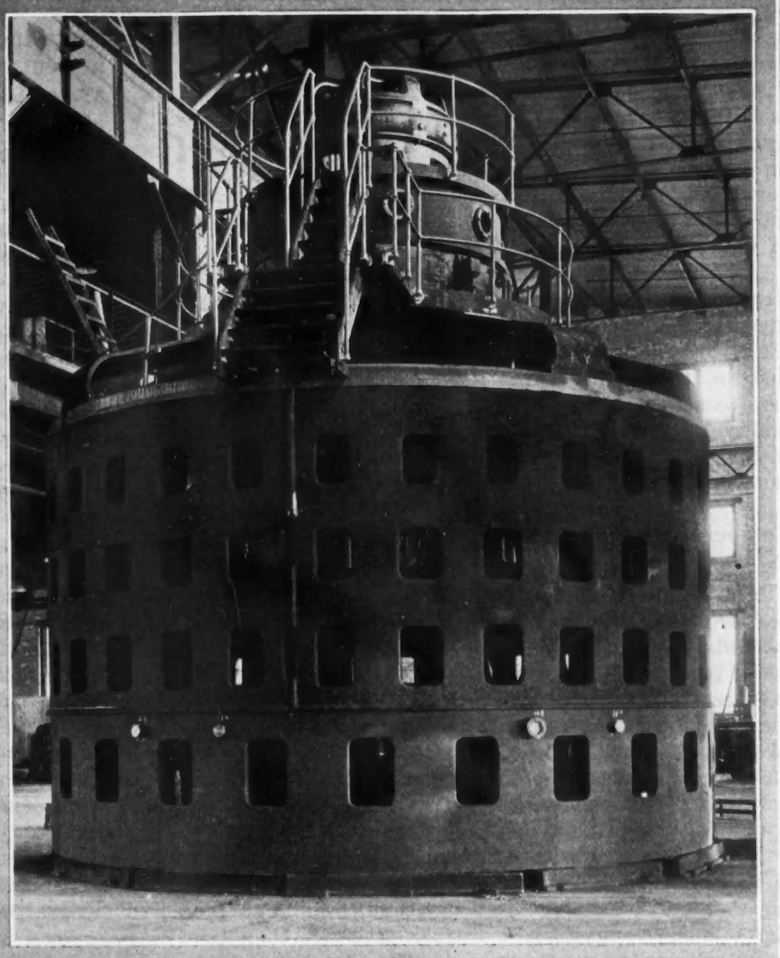
Notwithstanding the splendid development thus far attained, industrial electrification in Massachusetts, as elsewhere, challenges the best efforts of the engineer for future achievement. There are possibilities in the way of control equipment application, voltage standardization and drive design which will interest manufacturing plants for a long time to come. Fewer voltages for motor service are in use in Massachusetts than in some other highly industrial states, and this is to be commended. We are nowhere near finality, however, either in the collateral problems of motor driving or in the advance of the motor itself into fields at present served by other kinds of power equipment. Switching, fusing, rating—these and other matters await the attention of the engineer in pursuit of betterments in existing installations as well as in new applications. To the alert electrical man the figures presented in this article are vibrant with suggestiveness.

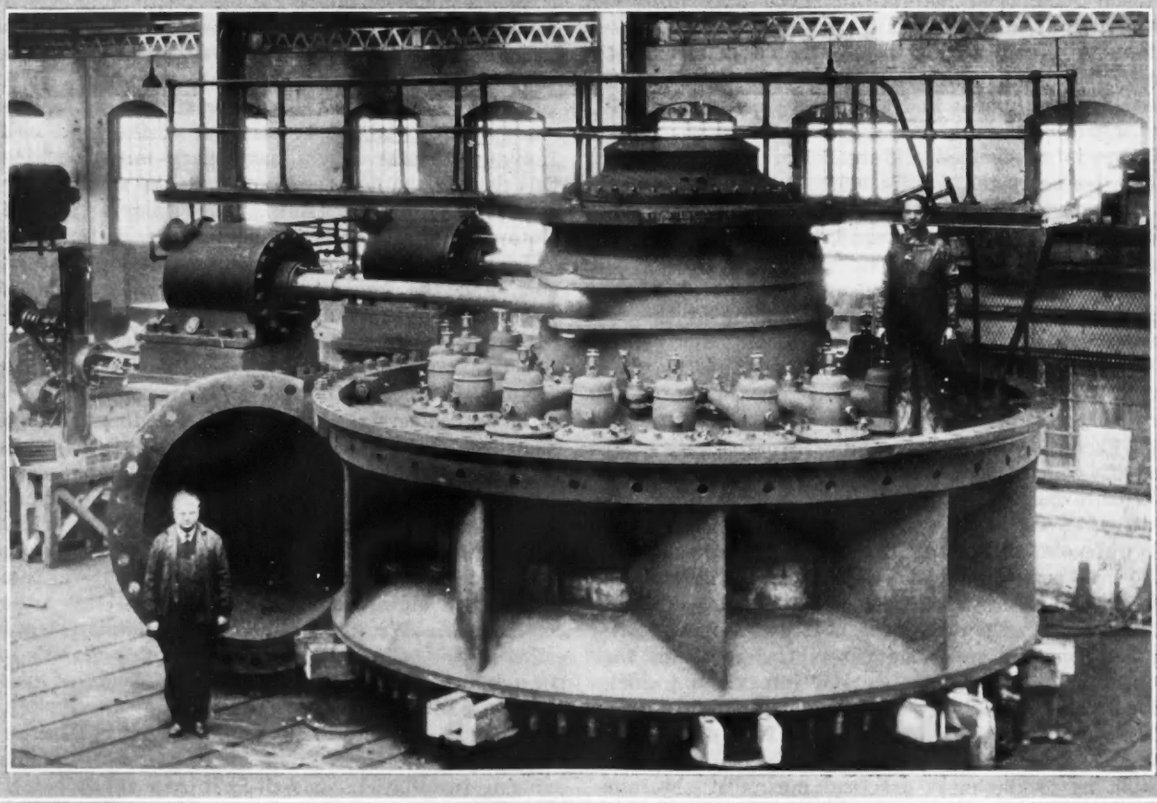
55,000-Hp. Generator and Waterwheel of the Chippawa-Queenston Development

TWO waterwheel-driven generators rated at 55,000 hp. (45,000 kva.) are now installed and operating in the new Chippawa-Queenston development of the Hydro-Electric Power Commission of Ontario. These units are fed from a forebay at the top of the Niagara River gorge, under a head of 305 ft., by 10-ft. penstocks. Gates are provided at the top and Johnson valves at the bottom of the penstocks. Both Moody spreading and ordinary curved draft tubes are installed.

The generators operate at 12,000 volts, three-phase, 25 cycles, and are capable of operating continuously at 49,500 kva. with either voltage or current 10 per cent in excess of rated value. The units are completely inclosed, air being drawn either from outside or from the generating room. Ample heat is available from the ventilating air (1.2 kw. per 1,000 cu.ft. of space) to heat the building at all times. Speed regulation is not difficult because of the ratio of penstock length to head and because of the flywheel effect of the generator rotors, namely, 21,500,000 WR^2.

The generator room floor runs along the level of the upper frame of the generator, leaving only the direct-connected exciter projecting above the floor. This relieves congestion on the generator floor yet allows placing auxiliaries closely to their corresponding generators.





Arrangement for Handling 500,000-Kw. Load from Queenston Plant

Most Economical Utilization of Water Power Available and Protection Against Interruption of Service Were Chief Factors Influencing Design of This New Station of Hydro-Electric Power Commission of Ontario

CONSIDERED from any point of view, the new Chippawa-Queenston hydro-electric development of the Hydro-Electric Power Commission of Ontario is a remarkable and unusual development. From a hydraulic viewpoint, it is particularly interesting in utilizing nearly 94 per cent of the available head between Lakes Erie and Ontario, for the unusual facilities provided to prevent ice troubles and minimize the loss in head from intake to wheels and for its hydraulic efficiency (approximately 30 hp. per cubic foot). Its waterwheels, of which there are now two installed and operating (ultimately there will be nine or ten) have the highest rating in existence, namely, 55,000 brake horsepower.

Electrically the plant is no less interesting. Chief among the features are the arrangement of the equipment and the provisions for handling the large power demand without interruption to service. For example, the generator room floor is on a level with the top of the generator frame, allowing auxiliaries to be placed closer to the unit; the control room is over the turbine room, and the electrical equipment is between the generator room and the side of the gorge in which the station is built. In addition, the circuit breakers are isolated from each other; a unit system will be used, involving double 12,000-volt buses and reactors between generators; exceptionally rugged bus structures are employed; differential relay protection is used extensively; the main units are designed for 185 per cent over speed, and facilities are provided for readily overhauling the turbine runners.

Water is taken from the Niagara River about 1 mile (1.6 km.) above the falls at Chippawa and is conveyed through an improved section of the Welland River a distance of 4½ miles (7.2 km.), thence by a canal 8½ miles (13.6 km.) long to the forebay and screen house situated on the Niagara River about a mile south of Queenston. From the screen house steel penstocks incased in concrete carry the water down the cliff to the power house, which is at the bottom of the gorge. Of the 327 ft. (99.6 m.) available head between Lake Erie and Ontario approximately 305 ft. (92.9 m.) will be utilized when the installation is complete.

The structure required to house five main units is 350 ft. (106.6 m.) long, but this length will be doubled ultimately for nine or ten units. Location of the transformer and switching equipment on top of the escarpment was considered, but owing to the difficulty of carrying the current at 12,000 volts from the generators to this point, the operating advantages in having a combined station, and the space available between the generator room and the cliff, it was decided to have the building house the transformers and switching equipment as well as the generating equipment. By constructing the generator-room floor on a level with the top of the generator frames space was provided at small cost for the exhaust air ducts, fans and generator-field equipment adjacent to the units, without obstructing the space around the generators on the main floor. As may be noted, the generator cooling air is drawn through ducts on the east wall of the station either from outdoors or from the inside. A longitudinal tunnel in the substructure facilitates the handling of the turbine runners and piping.

One generator, one bank of transformers and a line constitute a unit with a normal capacity of 45,000 kva. Since it is impracticable to dispose of power in blocks of this size, however, grouping of units is essential. For this purpose 12,000-volt and 110,000-volt buses are provided. At present only one 12,000-volt bus, with reactors between generators, is installed, but space is provided for a second or emergency bus.

To determine the mechanical, magnetic and thermal effects on conductors and the normal and abnormal operating conditions, extremely interesting studies were carried out with different groupings of equipment. From the studies it was found that the star bus has a slight advantage over the ring bus with not more than four generators operating in parallel in so far as short-circuit currents are concerned. With more than four generators in parallel, however, the short-circuit current with the star bus is considerably higher.

Reactors Used Between Generators

With eight generators operating in parallel and no reactors between units, the root-mean-square value of the first wave of the symmetrical short-circuit current may reach a value of 140,000 amp. Using 4 per cent reactance (based on a 45,000-kva. generator) in bus reactors between generators connected to a ring bus 73,000 amp. would result. If the star bus were used 104,000 amp. would result. Under such conditions the forces exerted between buses would be extreme with a 2-ft. (0.6-m.) spacing, so it was decided to install 5 per cent bus reactors between the generators and to mount the buses 48 in. (1.2 m.) apart. Further increase in the reactance between generators would cause only slight reduction in the short-circuit current.

The generating units are each rated at 45,000 kva., 80 per cent power factor, 12,000 volts, three-phase, 25 cycles, at 187.5 r.p.m. They are capable of being operated continuously at 49,500 kva. with 110 per cent normal voltage or current. As may be observed the units are the vertical type with direct-connected exciters. The over-all efficiency of the units is slightly in excess of 97 per cent at the rated power factor.

Units Nos. 1, 2 and 3 are all of the same make, having a rotor with cast-steel spider and laminated sheet-steel rim dovetailed to the spider. The upper and lower brackets are provided with Kingsbury thrust bearings. In the slot portions of the armature the windings are insulated with iron on sheet-mica insula-

tion, whereas the end portions are insulated with mica and varnished-cambric tape. Units Nos. 4 and 5 were made by a different manufacturer and have a rotor made up of seven cast-steel sections, five of which carry the pole pieces and the other two, one above and one below, provide additional flywheel effect (21,500,000 WR^2 total). Spring-supported thrust bearings are used in these units. The armature coils are insulated throughout with mica tape. The rotors of all the units are required to withstand 185 per cent of normal speed, and the armature insulation is tested for 30,000 volts.

Aside from the normal excitation furnished by direct-connected exciters, auxiliary or emergency excitation can be furnished by a motor-generator set which can be connected to work with the voltage regulator belonging to any one of the main units At present there is only one auxiliary exciter for five units, but in the completed station additional sets will be installed.

Vibrating relay-type voltage regulators are employed which are equipped with compensation to prevent cross-currents when units are in parallel and to allow for ohmic and inductive drop in transformer banks and lines. Each regulator is also provided with a device maintaining a low maximum of exciter voltage in case of a drop of voltage due to short circuit, and also with a device for limiting the voltage in case of overvoltage due to overspeed or other causes. No main-generator-field rheostats are used.

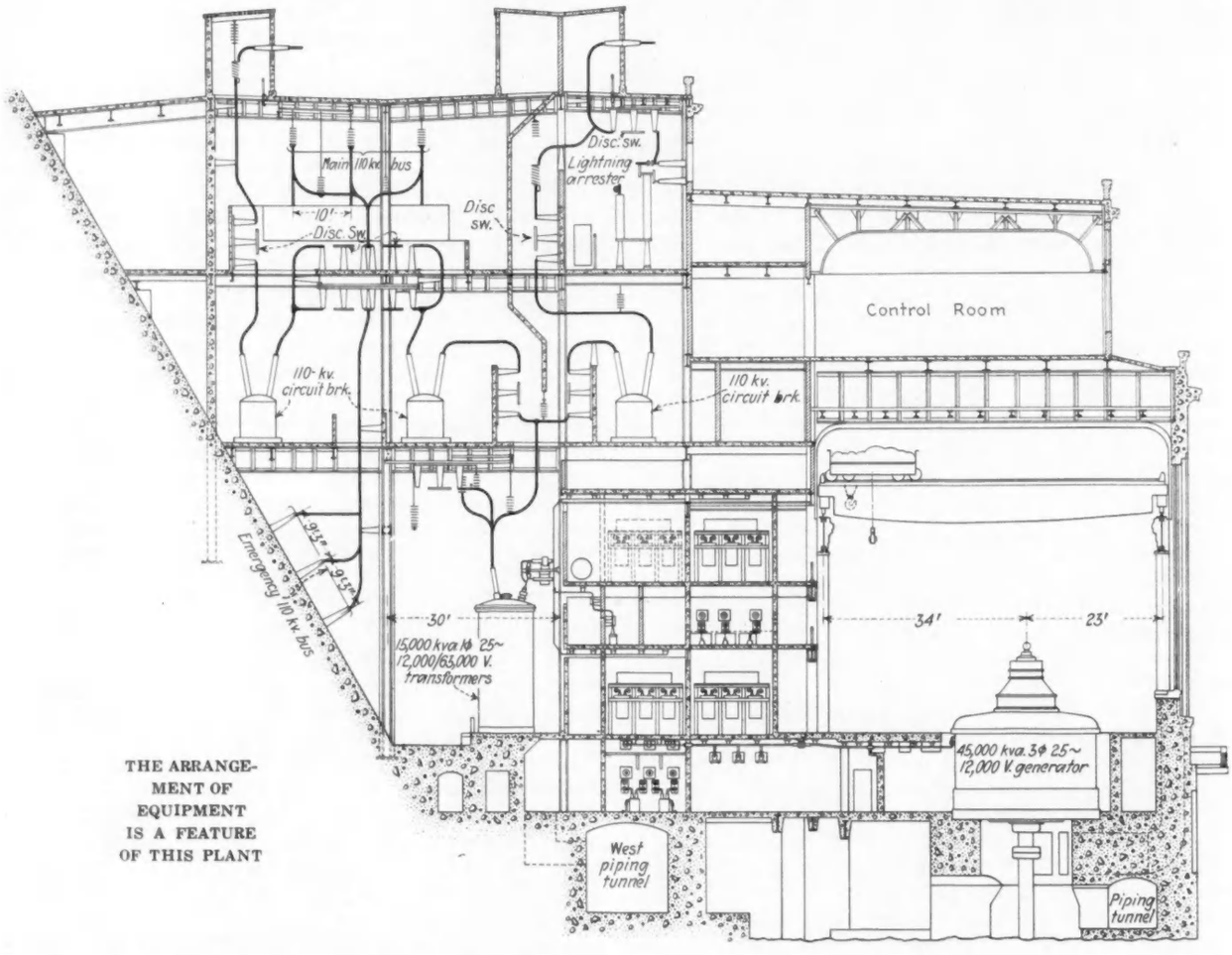
Oil circuit breakers for 12,000-volt service are rated at 15,000 volts, 3,000 amp., continuous capacity. One type, used principally with units Nos. 1 and 2, is solenoid-operated and has one 36-in. (90-cm.) steel tank per pole. Inverted brush-type contacts with two breaks in series are used. To obtain a high rupturing capacity a large amount of oil under considerable head is employed.

Motor-operated oil circuit breakers with two grounded tanks per pole are used with units Nos. 3, 4 and 5. The arc is broken under oil in an explosion chamber arranged with baffles to direct a stream of cool oil under pressure across the path of the arc. Contacts of the wedge and finger type are used.

For 110,000-volt service oil circuit breakers rated at 135,000 volts, 600 amp., continuous capacity, are used. They are operated by solenoids and have one tank per pole. Each pole has four breaks in series, arrangement being made for quick separation to increase the rupturing capacity.

The 12,000-volt circuit breakers are installed in separate rooms on two floors between the generator room and the transformers, with the main buses occupying an intermediate floor. These rooms are ventilated to the generator air-discharge shaft. The breaker leads run through bushings in the rear wall.

The position of the 110,000-volt circuit breakers is shown in the accompanying cross-section of the plant. The breaker on the direct circuit from the transformer bank to the transmission line is separated entirely from all other breakers by walls. Each unit group of breakers is in one room.



THE ARRANGEMENT OF EQUIPMENT IS A FEATURE OF THIS PLANT

Very strong construction was required for the 12,000-volt bus and connections from the generator terminals to the transformer terminals. No cable could be used for any of these connections. On the basis of the short-circuit current analysis previously mentioned, it was finally decided to adopt a spacing of 48 in. (1.2 m.) for the main buses, breakers and transformer connections and 37 in. (0.92 m.) for the generator lead to the buses. With these spacings and a calculated short-circuit current having an asymmetrical peak of 170,000 amp., the maximum forces exerted on the buses per foot of length would be 485 lb. per foot (720 kg. per m.) for the 48-in. spacing and 630 lb. (907 kg.) for the 37-in. spacing. By using a single-unit porcelain bus support having an ultimate cantilever strength of 10,000 lb. (4,535 kg.) it was possible to space the supports along the bus about 5 ft. (1.5 m.) apart and still obtain a factor of safety of three under maximum load conditions. These supports have a smooth surface, cemented-on cast-iron hardware, and a flashover strength of 80,000 volts at 25 cycles.

Three 4-in. x ¼-in. (10-cm. x 6.3 mm.) copper bars laid flat on the insulator cap were adopted for buses. By attaching the bus supports directly to the floors and walls it was possible to dispense with the usual barriers and also to place the buses in the position of greatest resistance to mechanical deformation. Since the sagging of the copper due to its own weight is a limiting factor in the arrangement adopted, it was not possible to space the bus supports at the maximum distance considering the short-circuit forces involved. Another interesting fact brought out in laboratory tests prior to the installation of buses was that there is a real danger in supporting the buses in such a manner that their natural period of vibration will coincide with the frequency of the stresses set up by magnetic action.

On each side of every oil circuit breaker are 3,000-amp. disconnecting switches mounted in separate rooms behind the breakers and operated by hand wheels outside the room. The mechanisms may be locked in the open or closed position by individual Yale locks. Beside the hand-operating mechanism are pilot lamps indicating the position of the switches and whether the corresponding oil circuit breakers are open or closed. This system was chosen to avoid the complication of a mechanical or electrical interlock.

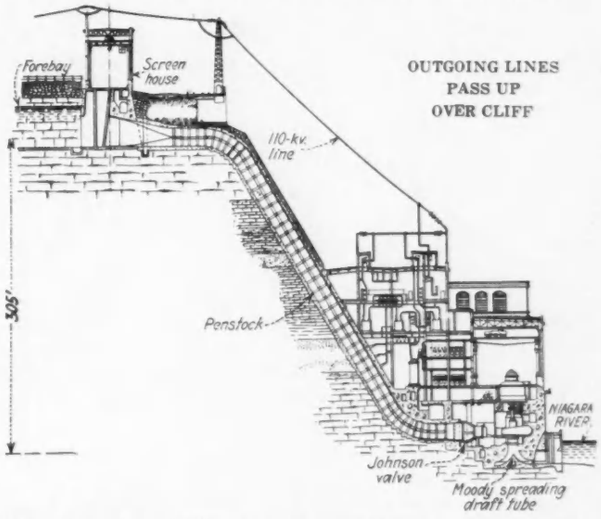
To allow a continuous current-carrying capacity of 600 amp. in the 110,000-volt circuits, it was necessary to use 1-in. (2.5-cm.) (iron-pipe-size) copper tubing, Since the potential may ultimately be raised to 135,000 volts, standard 42-in. (106-cm.) corrugated single-piece porcelain posts with cemented-on cast-iron hardware were installed. These posts have a cantilever and torsional strength of 40,000 in.-lb. (45,500 cm.-kg.) and a dry flash-over value at 25 cycles of 350,000 volts. For the high-voltage circuits 600-amp. double-break disconnecting switches operated by hand mechanisms in gangs of three were adopted.

Reactors are installed only between the main 12,000-volt bus sections—that is, between generators. They are of the cast-in concrete type with the concrete and conductors impregnated with varnish. They will safely carry short-circuit current for twelve seconds and are rated at 5 per cent, based on the normal current of the generators. Protective resistors are mounted within the reactors and connected to the terminals. These reactors are located on the generator floor below the 12,000-volt circuit-breaker rooms.

The main step-up transformers are of interest particularly because of their great physical size and heavy short-circuit currents to which they may be subjected. They are rated at 15,000 kva., 25 cycle, 12,000/75,000 volts, and are connected in delta-star. The interleaved type of construction with alternate groups of primary and secondary coils is employed.

The simplicity of the main connections in the plant, and especially the absence of 12,000-volt feeders, made it possible to use differential relay protection extensively. To insure correctness of operation the following precautions were taken: First, current transformers of special design were used to give correct ratio even with heavy current; second, impedance in secondary wiring has been kept low by short connections; third, current transformers are placed outside the oil circuit breakers which would isolate any group so that a defective breaker would be cleared on both sides.

All differential relays are of the instantaneous overload plunger type except for transformer differential



protection, in which case inverse-time overload induction-type relays are used. The generator differential relays also have a hand-reset feature to increase the certainty of operation. Each differential group of relays is arranged with multiple-contact relays to trip the circuit breakers isolating the defective equipment. The generator differential relays also trip the field breakers.

Besides the differential relays, the following protective equipment has been installed: (1) A ground circuit relay giving an alarm in case of a ground current; (2) a directional relay on each generator, which will trip the generator oil circuit breakers in case of careless synchronizing; (3) a ground relay on the 12,000-volt connections close to the transformer bank on each unit; (4) a set of inverse-time overload relays of the induction type on each outgoing line; (5) a set of inverse-time overload relays in the main 12,000-volt bus between generators to separate them in case any units drop out of step with each other.

All current transformers on the main circuits are of the bushing type, those for 12,000-volt circuits having the core and secondary winding mounted on condenser bushings over the busbars. This arrangement permits several secondary lines on the same bushing.

For the information incorporated in this article the ELECTRICAL WORLD is indebted to E. T. J. Brandon, electrical engineer of the Hydro-Electric commission. F. A. Gaby is chief engineer of the commission.

Conditions in Europe that Affect American Electrical Exporters

Discussion of the Obstacles to and the Benefits from Export Business—Where the Market Lies for Specific Lines of Manufactures—European Standards Which Differ from Those of America—Local and Economic Conditions

By JOSEPH McELROY, 3D, and P. S. SMITH*

WHEN we consider the possibilities of the sale of American electrical products in Europe we are confronted by an entirely different condition from that which faces us when considering South American business or business with the Orient in general. The reason is that Europe is the great manufacturing section of the world and in many instances does not consume all that she herself produces. Moreover, the existing exchange rate in nearly every country of Europe at present exercises a decided influence against us in our business relations with these countries.

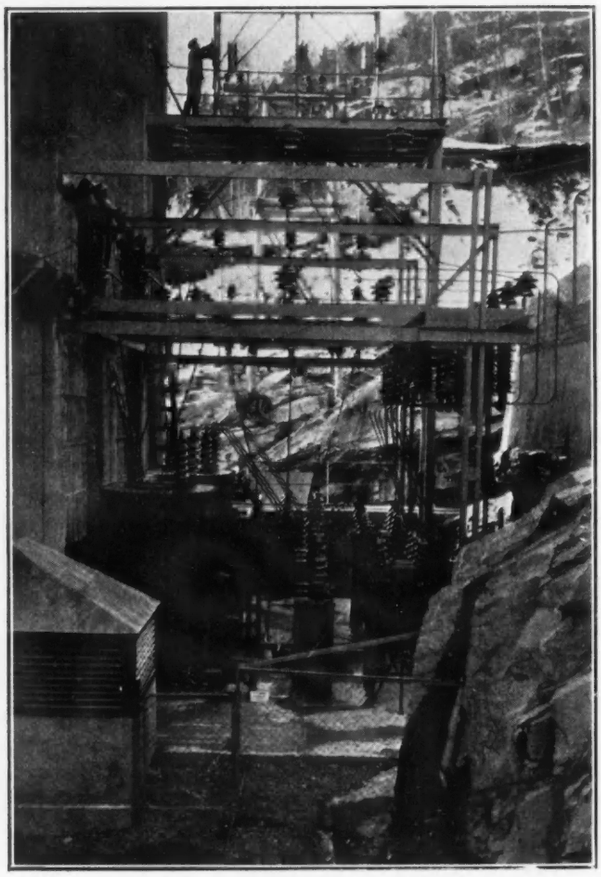
The most recent reliable figures indicate that about 22 per cent of the population of Norway use or are served with electricity, 18 per cent in Sweden, 17 per cent in the British Isles, 17 per cent in Germany, 15 per cent in Holland, 13 per cent in Italy, 12 per cent in France, 5 per cent in Portugal, 3 per cent in Spain and 2½ per cent in Russia, with a smaller percentage in smaller countries not named. Therefore, roughly speaking, there is a diversified potential market for the sale of electrical apparatus and appliances in the countries specified, embracing a population of 34,075,000. The next question is whether the American manufacturer is in a position to take advantage of this potential market.

THE PRODUCING COUNTRIES

It is generally conceded that Germany, next to the United States, is foremost in electrical development and in the manufacture of electrical machinery and supplies, and if any industry in Germany has come through the war in good condition, it is the German electrical industry, which has succeeded in paying large dividends to its stockholders in the last two years. Germany, therefore, is to be considered as a formidable competitor if an American manufacturer attempts to sell his wares in Europe.

England also is a large manufacturer of electrical machinery and supplies. France, Italy, Switzerland, Spain, Norway and Sweden too manufacture electrical material of various kinds, and on account of the low cost of labor their prices are usually cheaper than those of the manufacturers of the United States, especially on small articles. To this at present is to be added the handicap of adverse exchange, so that until conditions become more settled in Europe it will be difficult to sell American electrical articles on that continent. By difficult, however, is not meant impossible, but that each individual manufacturer must give the matter intensive study if he is to succeed.

The electrical products of these principal European countries are naturally manufactured according to their own designs and standards, which in many ways are different from ours. The prejudices formed by the consuming public are naturally very strong because the people have always been accustomed to these types. The introduction of entirely new designs is therefore attended by expense and demands determined effort. The willingness with which these conditions are met will mean much in determining the measure of success attainable by outside manufacturers, who, in addition, have to contend with the handicap of greater distance from their prospective markets.



NEW BJOLVE OUTDOOR TRANSFORMER SUBSTATION, NORWAY, BUILT OF WESTINGHOUSE MATERIAL

It must be remembered, however, that against this export business offers many distinct advantages and benefits. It provides an even market in periods of depression at home, with a broad diversity factor that tends to equalize the demand and eliminate seasonal peaks and hollows. Foreign business is apt to be very permanent in character, and it reduces naturally the overhead on domestic business.

A very comprehensive table showing the value of all

*Mr. McElroy is export sales manager for Pass & Seymour, Inc. Mr. Smith is associate editor of *Ingeniería Internacional*.

electrical material sent to Europe was published in the issue of the ELECTRICAL WORLD for March 4, 1922. In it are shown separately the principal countries and each item of manufacture as listed by the statistical division of the Department of Commerce. A close analysis of these figures tells where American goods have gone in the past. It is the purpose of this article to show where they can be expected to go in the future, and it is reasonable to believe that the countries which have purchased these American products in the past will be the most likely customers in the immediate future.

GENERATING AND TRANSMISSION EQUIPMENT

Generating equipment in both large and small sizes is in constant demand in Europe. The amount of new installation possible during the last eight years was far below normal, but the demand has been growing, and owing to the readjustments in the industrial centers it will continue its upward trend. In some sections plans are already made to take care of it by developing water-power sites on a very ambitious scale. This may not always open a market for equipment from the United States in the immediate vicinity of the producing centers, but it surely will in the outlying districts and smaller countries. Our control and measuring devices, switchboards and protective apparatus should enjoy a large share of this business.

Towers and the smaller structures for transmission lines will come in for a big increase in sales, in which American types may expect to participate. Recent information regarding prices and production costs in the steel industry tend to place American material, both raw and fabricated, well ahead of many of the principal competitors in Europe. There is scarcely any other source of supply than the United States for wire and cable of copper or aluminum. The competition, however, is much keener on the insulator, both low-tension and high-tension.

Electric power has long been employed in the industrial countries, thus making a constant supply of motors, switches and all accessories indispensable. Standard types are oftentimes supplied by home manufacturers, but there is room for our numerous special devices, such as oil switches and "safety first" apparatus. The motors themselves are more difficult to sell. This is partly due to features of design with which American motors are not equipped, as, for example, slip rings and wound rotors on small sizes.

Two prominent factors in an even greater future use of electric power are the loss of man power due to the war and the increasing cost of production due to a multiplicity of more or less obvious reasons. It is necessary only to recall the kinds of manufacturing carried on in Europe, such as iron and steel, boot and shoe, furniture, automobile and textile, to realize the quantities of material required to keep the wheels turning.

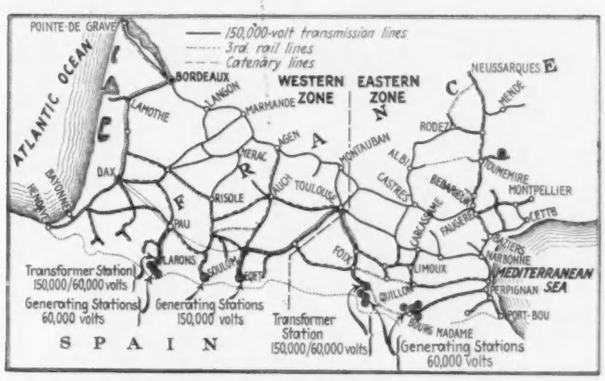
RAILWAY ELECTRIFICATION

Railway electrification provides one of the large markets for heavy materials. The three different systems of electrification—direct-current, single-phase and three-phase—have each had their advocates, with the two former in the lead. An earnest effort is being made now to arrive at some criterion by which standardization may be put into effect in so far as possible. This field, however, offers relatively small attraction to American manufacturers, since the local engineering firms are well equipped and able to handle any business.

More interesting possibilities seem to lie in the light traction or street-railway field, especially for overhead supplies, rail bonds and similar materials. Welding equipment, track grinders and shop machinery in general are coming more into vogue than ever, and much of this is new abroad. It should be brought to European attention in an educative manner, the economical features being brought out prominently.

TELEPHONE AND TELEGRAPH

Telephone and telegraph systems are in general operated by the several governments as income-producing utilities. This restricts the sale of appropriate materials to comparatively few customers and introduces many special features into all transactions, as is true in every case where it is necessary to sell to a government bureau or department. For this reason all attempts to introduce new material should be carried on personally by a competent representative of the



MAP OF FRENCH RAILROAD ELECTRIFICATION NOW UNDER CONSTRUCTION

manufacturer, and a resident representative is frequently of imperative necessity for handling the larger deals. In point of design it should be borne in mind that many telephone systems want only the type of instrument consisting of a combined transmitter and receiver rather than the separate devices to which we are accustomed.

The wireless telephone is now being used for broadcasting in England, France and Germany. In both France and Germany broadcasting is controlled and operated by the government, for reasons of economic necessity, as a further source of income. The sets are rented and are fixed as regards wave length so that only the class of service paid for can be received on any one instrument. It has been provided that a greater degree of liberality in their use will be permitted before long, thus opening up a field of many possibilities.

WHERE SPECIFIC MARKET LIES

It is impossible, of course, to lay down any hard and fast rules as to what to sell in Europe and where to sell it, but the following list of outstanding export lines will indicate the present trade tendencies and the most promising fields for development by American manufacturers:

Batteries may be sold in Denmark, France, Italy, Netherlands, Norway, Portugal, Spain, Sweden and Great Britain.

Carbons may be sold in France, Italy, Netherlands, Norway, Portugal, Spain, Sweden and Great Britain.

Generators may be sold in Denmark, France, Italy, Norway, Portugal, Spain and Great Britain.

Fans may be sold in Spain and Great Britain.

Heating and cooking appliances may be sold in France, Italy, Norway, Portugal, Spain and Great Britain.

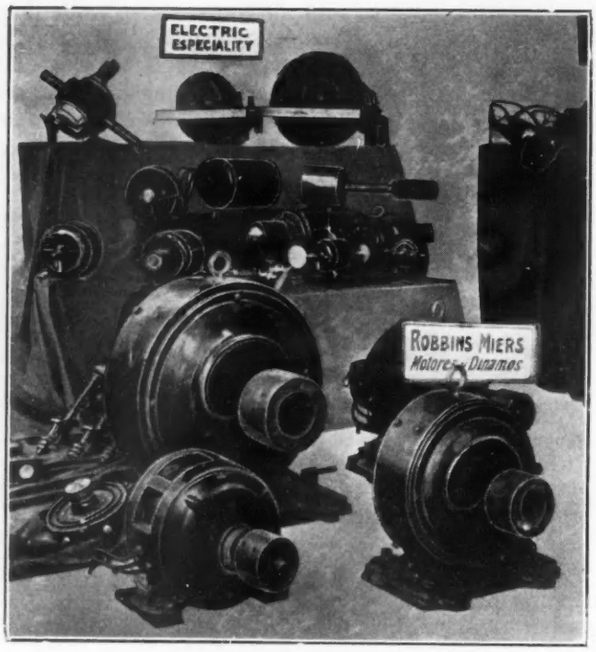
Insulated wire and cables may be sold in Denmark, France, Italy, Norway, Portugal, Spain, Sweden, Switzerland and Great Britain.

Interior-wiring supplies, etc., including fixtures, may be sold in Denmark, France, Italy, Norway, Portugal, Spain, Great Britain and Switzerland.

Arc lamps have practically no market in Europe, as they are giving way to incandescent units.

Carbon-filament lamps have sold principally in Italy.

Metal-filament lamps may be sold in France, Italy, Portugal, Spain and Great Britain, although competition from local and other European factories greatly reduces the opportunity.



DISPLAY OF MOTORS AND MOTOR APPLIANCES IN AN EXPOSITION IN MADRID, SPAIN

Magnetos and spark plugs may be sold in Denmark, France, Italy, Norway, Portugal, Spain and Great Britain.

Meters and measuring instruments may be sold in France, Italy, Norway, Spain and Great Britain.

Motors may be sold in Belgium, France, Denmark, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and Great Britain.

Switches and accessories may be sold in France, Italy, Norway, Portugal, Spain and Great Britain.

Telegraph apparatus, including wireless, may be sold in Denmark, France, Italy and Great Britain.

Telephones may be sold in France, Italy, Netherlands, Spain, Portugal, Switzerland and Great Britain.

Transformers may be sold in France, Italy, Norway, Spain, Switzerland and Great Britain.

EUROPEAN STANDARDS

Naturally a patented American electrical novelty will sell where an article made under competitive conditions would not. In the British Isles and France, for instance, it is obvious that Edison screw sockets cannot be sold because the British people use the bayonet type of lamp base. Articles such as heating devices and portable lamps must therefore be equipped with the bayonet-type plug to fit in the bayonet socket or receptacle, and if merchandise is sent abroad with the Edison screw plug this one detail may kill the sale. In each country will be found such special requirements or special methods of installation, and these must be studied before the sale of American products is attempted.

For an American manufacturer of conduit and fittings to attempt to sell his product in Europe without knowledge of the fact that the German-type Bergman tubing is largely used would be disastrous. The American manufacturer of pull-chain devices must also understand that this is considered a novelty and that lighting devices and fixtures are usually equipped with keyless sockets operated by a switch from the wall. When trying to sell large apparatus or material to be used in connection with electric railways or trolleys, it must be known that engineers of the various countries of Europe have their own ideas as to specifications and needs and that it takes a great deal of educational work to show them where the American methods or the American types of apparatus will perform their work better or perhaps more cheaply.

This educational work cannot be done except by a person who has been trained technically and who is conversant with the articles that he is endeavoring to demonstrate. There is, however, the possibility of making a large sale of electrical apparatus running into a considerable sum of money, and some of the large American electrical manufacturers have obtained very satisfactory business from Europe. In all instances, however, they have given the matter the careful analysis and investigation that is here recommended.

LOCAL AND ECONOMIC CONDITIONS

If we were to turn to countries like Norway and Sweden and endeavor to sell apparatus that has for its chief recommendation the saving of electrical energy, this would not be of great interest in these countries because their energy is generated by water power and is plentiful and cheap. On the other hand, the argument would hold good in Denmark, where energy is scarce and dear.

In Russia it will be impossible to take advantage of the market until a stable government has been established. In the southeastern part of Europe, taking in the old empire of Austria-Hungary, the Balkan States, Turkey and Greece, finances in general are not in a sound condition and extreme caution should be used in accepting orders if they are tendered. Of course, where large railroads or power stations or trolley systems are contemplated, it is quite possible to obtain some form of a government or a semi-government financial guarantee with which the American manufacturer may feel that he is protected. But on shipments of ordinary size it is not considered good judgment under today's conditions to extend the terms of credit usually demanded by the inhabitants of these countries.

It is, of course, difficult in a short article to cover fully the market situation in Europe as it concerns the American manufacturer. Many articles of our production can be sold there. It requires knowledge to discriminate successfully and patient attention to develop profitable business, but the reward through the coming years will fully justify the effort. Thorough investigation is vital, lest costly mistakes be made. Moreover, good service is as essential in the foreign field as elsewhere, and to maintain it the greatest care must be given to the selection of the men who are to represent the exporting manufacturer and build up friendly relations for him in the foreign field.

Textile Mills Lead in Industrial Energy Consumption in Massachusetts

Almost Two-thirds of the 1,606,105,000 Kw.-Hr. Consumed by Industrial Plants in 1920 Was Purchased from Central Generating and Distributing Systems—Of the 117,038 Installed Motors More than Half Are Under 5 Hp.

By ROBERT M. DAVIS
Statistical Editor ELECTRICAL WORLD

ALTHOUGH the industrial status of Massachusetts was established many decades before the advent of electrical energy, yet the factories and mills of that state have adopted this new form of motor-power to an extent probably equaled by only a few other states of the Union. More than 62 per cent of the primary horsepower of the state is electrical, and more than 1,600,000,000 kw.-hr. of electrical energy is consumed annually by its industrial establishments.

During the past two years the ELECTRICAL WORLD has conducted a country-wide survey to ascertain the extent to which electrical energy is being used by the various industries. This survey has been undertaken by states, and Massachusetts is the fifteenth in the series. A detailed analysis of the industrial load of California appeared in the ELECTRICAL WORLD for Aug. 28, 1920. A similar analysis of the industrial load of the Southern States appeared in the issue of June 25, 1921, and the industries of New York, Pennsylvania and Indiana were covered in the issues of July 20, 1921; Dec. 31, 1921, and Feb. 18, 1922, respectively. Returns are now being received from Ohio, Illinois, Michigan and New Jersey, and the analyses of these states will appear in early issues of the ELECTRICAL WORLD.

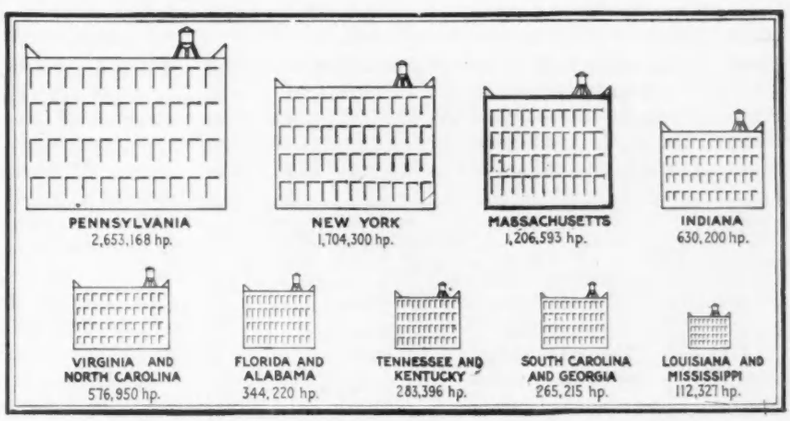


FIG. 1—HOW MASSACHUSETTS COMPARES IN ELECTRICAL POWER WITH OTHER STATES COVERED TO DATE BY THE "ELECTRICAL WORLD" SURVEY

The survey conducted to ascertain the use of electrical energy by the various industries of Massachusetts involved the sending out of about 2,800 questionnaires to the larger manufacturing plants. A summary of the replies received and estimates of the total operations and power equipment are presented in the accompanying tables.

The Census of Manufactures for 1919 indicates that

TABLE I—SEGREGATION OF THE INDUSTRIAL LOAD IN THE STATE OF MASSACHUSETTS

These data are compiled from an industrial survey being conducted by the McGraw-Hill Company, Inc., under the supervision of the editorial departments of the ELECTRICAL WORLD and *Power*, and cover plants in all industries employing more than fifty operatives

Industry	Companies Reporting: Total Number	Companies Reporting: Number Using Electrical Energy	Electric Generators—Direct Current: Number	Electric Generators—Direct Current: Total Rating, Kw.	Electric Generators—Alternating Current: Number	Electric Generators—Alternating Current: Total Rating, Kw.	Electrical Energy Consumed: Privately Generated, Kw.-hr.	Electrical Energy Consumed: Purchased, Kw.-hr.	Motors Installed: Number	Motors Installed: Total Rating, Hp	Motors Installed: Number Under 5 Hp.	Distribution of Drives: Belt	Distribution of Drives: Chain	Distribution of Drives: Direct or Geared
Chemicals	34	22	16	1,170	7	2,256	4,772,350	16,643,079	1,624	16,423	682	1,226	91	307
Electrical equipment and machinery	20	10	3	995	4	13,500	22,021,313	3,386,960	9,173	28,832	7,414	6,726	87	2,360
Food and kindred products	22	12	11	1,100	5	5,930	8,667,200	4,438,848	1,473	12,019	493	1,245	33	195
Iron and steel and their products	228	161	55	5,739	54	11,061	20,512,709	64,045,025	8,478	102,564	2,376	6,530	248	1,700
Leather and its products	63	45	21	2,007	1	9,195	12,258,705	7,243,746	3,215	17,933	1,982	2,990	93	132
Lumber and its products	61	27	5	288	7	1,154	2,357,176	2,977,714	513	4,689	164	451	3	59
Metals and metal products other than iron and steel	28	18	7	367	1	450	803,000	1,869,047	282	4,965	111	264	5	13
Paper and printing	63	47	31	2,691	52	36,691	118,024,232	31,582,420	3,141	50,734	1,344	2,630	71	440
Railroad repair shops	1	1	0	0	3	1,200	4,070,000	0	213	5,000	31	72	4	137
Stone, clay and glass	17	9	0	0	8	4,225	4,210,615	2,008,410	523	4,137	243	252	179	92
Textiles	336	229	90	5,331	134	100,025	139,123,213	113,958,665	13,547	165,093	6,440	8,400	1,324	3,823
Vehicles for land transportation	3	3	0	0	0	0	0	3,009,120	110	1,716	66	98	0	12
Miscellaneous	45	29	8	768	8	1,747	2,415,670	5,755,519	916	10,718	366	634	50	232
Rubber	20	14	9	539	11	7,735	13,256,358	60,880,461	2,605	39,740	684	1,242	135	1,228
Totals for all industries of Mass.	941	627	256	20,995	305	195,169	352,512,541	317,804,044	45,813	464,643	22,396	32,754	2,319	10,730

TABLE II—"ELECTRICAL WORLD" ESTIMATE OF THE USE OF ELECTRICAL ENERGY IN MASSACHUSETTS IN 1920
(Based on industrial survey federal and state census data)

Industry	Electric Generators: Direct-Current No.	Direct-Current Total Rating, Kw.	Alternating Current No.	Alternating Current Total Rating, Kw.	Electrical Energy Consumed: Generated Private Plants, Kw.-hr.	Purchased from Public Utilities, Kw.-hr.	Total Energy Consumed
Chemicals	21	1,496	9	2,880	6,110,000	19,800,000	25,910,000
Electrical equipment and machinery	7	2,330	9	31,600	51,500,000	8,100,000	59,600,000
Food and kindred products	12	1,178	5	5,930	9,130,000	36,200,000	45,510,000
Iron and steel and their products	73	7,630	72	14,700	27,340,000	103,000,000	130,340,000
Leather and its products	27	2,530	14	11,650	15,500,000	59,250,000	74,750,000
Lumber and its products	11	628	15	2,520	5,125,000	20,200,000	25,325,000
Metals and metal products other than iron and steel	52	4,450	86	61,000	1,330,000	16,700,000	18,030,000
Paper and printing	32	2,740	53	37,350	120,000,000	207,000,000	327,000,000
Railroad repair shops	....	.....	4	1,490	5,060,000	5,210,000	10,270,000
Shipbuilding	....	.....	....	.....	0	1,310,000	1,310,000
Stone, clay and glass	....	.....	8	4,225	4,210,000	29,900,000	34,110,000
Textiles	223	13,220	332	248,000	345,500,000	312,000,000	657,500,000
Vehicles for land transportation	3	258	1	138	1,350,000	16,500,000	17,850,000
Miscellaneous	9	845	9	1,920	26,600,000	38,900,000	65,500,000
Rubber	10	588	12	8,440	14,500,000	98,600,000	113,100,000
Totals for all industries of Massachusetts	480	37,893	629	431,843	633,435,000	972,670,000	1,606,105,000

Massachusetts ranks fifth as an industrial state, with a total capital investment of $2,964,177,000 and manufactured products valued at $4,007,452,000. Industrial growth in this state has been consistent except that the number of establishments, proprietors and firm members decreased during the period from 1914 to 1919. During this period, however, the value of manufactured products increased 144.4 per cent, wages increased 142 per cent, capital 91.4 per cent, number of salaried employees 50.6 per cent, primary horsepower 23.8 per cent and number of wage earners 17.6 per cent.

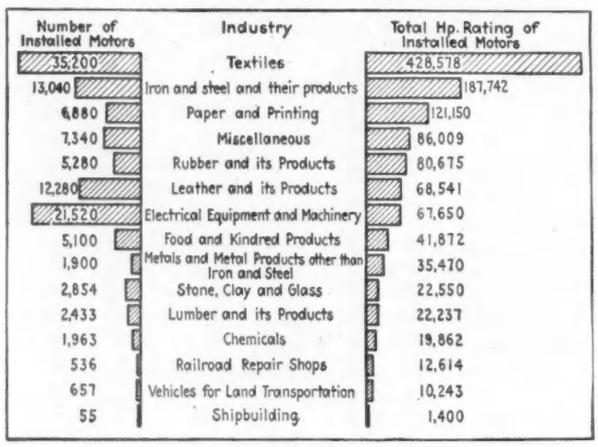


FIG. 2—DISTRIBUTION OF INSTALLED MOTORS AMONG THE VARIOUS INDUSTRIAL GROUPS OF MASSACHUSETTS

The returns received from the survey have been grouped into fifteen general industries, as indicated in Table I. The data are for the year 1920. Complete returns were received from 941 mills and factories employing fifty or more operatives each, and the companies reporting represented every industrial section of the state. Of these plants 627 reported the use of electrical energy as their main source of power. Reports from only a part of the industrial plants of the state such as were received by the ELECTRICAL WORLD are useless, however, for practical purposes except as they are used as a basis for an estimate of the use of electrical energy by all the industrial plants of Massachusetts. The ELECTRICAL WORLD has accordingly made such an estimate for the various items covered in the survey, based upon the information given in the reports received and supplemented by federal census data. These estimates are presented in the accompanying tables.

The total consumption of electrical energy by the mills and factories of Massachusetts during 1920 is

TABLE IV—DIRECT-CURRENT MOTOR-OPERATING VOLTAGES OF INDUSTRIAL PLANTS IN MASSACHUSETTS

Industry	Number of Companies Reporting Various Motor-Operating Voltages: 110	115	120	220	230	250	440	500	550
Chemicals	1	..	1	2	..	..	..	..	1
Electrical equipment and machinery	..	..	..	1	..	..	1	..	..
Food and kindred products	..	..	..	1	..	..	1	..	..
Iron and steel and their products	7	1	1	19	3	4	2	2	9
Leather and its products	..	..	..	3	..	..	..	..	..
Lumber and its products	1	..	1	..	..	..	1	..	2
Metals and metal products other than iron or steel	2	..	..	2	..	..	1	..	..
Paper and printing	2	2	2	3	2	2	1	..	5
Railroad repair shops	..	..	..	..	..	..	..	..	..
Stone, clay and glass	..	..	..	..	..	..	..	..	..
Textiles	8	..	1	9	1	2	1	1	6
Vehicles for land transportation	..	..	..	..	..	..	..	..	..
Miscellaneous	1	1	..	1	..	1	..	..	1
Rubber	2	1	..	4	..	..	..	..	1
Totals for all industries in Mass.	22	5	6	45	6	9	8	3	25

TABLE III—"ELECTRICAL WORLD" ESTIMATE OF NUMBER AND RATING OF MOTORS INSTALLED IN INDUSTRIAL PLANTS OF MASSACHUSETTS

Industry	Motors Run by Purchased Energy: Number	Total Rating, Hp.	Motors Run by Energy Generated in Private Plants: Number	Total Rating, Hp.	Total Motors in All Plants: Number	Total Rating, Hp.	Motors Under 5 Hp.	Distribution of Drives: Belt, Number	Chain, Number	Directly Connected, Number
Chemicals	1,500	15,180	463	4,682	1,963	19,862	825	1,481	111	371
Electrical equipment and machinery	2,920	9,190	18,600	58,460	21,520	67,650	17,400	15,790	200	5,530
Food and kindred products	4,060	33,300	1,040	8,572	5,100	41,872	1,710	4,310	114	676
Iron and steel and their products	10,300	124,600	2,740	63,142	13,040	187,742	3,650	10,050	376	2,614
Leather and its products	9,730	54,300	2,550	14,241	12,280	68,541	7,580	11,420	355	505
Lumber and its products	1,940	17,730	493	4,507	2,433	22,237	776	2,137	14	282
Metals and metal products other than iron and steel	1,760	31,000	140	4,470	1,900	35,470	748	1,778	34	88
Paper and printing	4,360	70,400	2,520	50,750	6,880	121,150	2,942	5,761	156	963
Railroad repair shops	272	6,400	264	6,214	536	12,614	78	181	10	345
Shipbuilding	55	1,400	.....	0	55	1,400	24	8	1	46
Stone, clay and glass	2,500	19,750	354	2,800	2,854	22,550	1,325	1,376	976	502
Textiles	16,700	203,200	18,500	225,378	35,200	428,578	16,700	21,830	3,440	9,930
Vehicles for land transportation	607	9,470	50	773	657	10,243	394	585	0	72
Miscellaneous	4,360	51,100	2,980	34,909	7,340	86,009	2,930	5,080	400	1,860
Rubber	3,470	52,900	1,810	27,775	5,280	80,675	1,045	1,898	206	1,876
Totals for all industries of Massachusetts	64,534	699,920	52,504	506,673	117,038	1,206,593	58,127	83,685	6,393	25,660

TABLE V—ALTERNATING-CURRENT MOTOR OPERATING VOLTAGES OF INDUSTRIAL PLANTS IN MASSACHUSETTS

Industry	Number of Companies Reporting Various Motor-Operating Voltages — Voltages																
	110	115	120	220	229	230	240	250	440	500	550	570	600	1,100	2,200	2,300	2,500
Chemicals	2	...	...	3	...	...	...	...	2	...	5	...	...	....	....	....	....
Electrical equipment and machinery	1	...	...	2	...	...	...	...	3	...	3	...	...	....	1	....	....
Food and kindred products	1	...	...	3	...	...	...	...	1	...	2	...	...	....	....	....	....
Iron and steel and their products	8	...	57	26	...	...	...	2	16	1	...	...	...	1	....	....	....
Leather and its products	2	...	...	12	...	...	...	1	...	1	8	...	...	...	....	1	1
Lumber and its products	1	1	...	2	...	...	...	...	1	...	8	...	1	....	....	....	....
Metals and metal products other than iron and steel	...	...	...	...	...	...	...	...	...	...	...	...	...	....	....	....	....
Paper and printing	1	...	...	7	...	2	...	...	3	...	15	...	4	....	....	2	....
Railroad repair shops	...	...	...	...	...	...	...	...	...	...	...	...	...	....	....	....	....
Stone, clay and glass	...	...	...	4	...	...	...	...	...	...	2	...	1	....	....	....	....
Textiles	8	1	...	47	...	...	1	...	3	2	61	1	5	....	4	2	....
Vehicles for land transportation	...	...	...	...	...	...	...	...	...	...	1	...	...	....	....	....	....
Miscellaneous	5	...	...	7	...	...	...	...	2	...	5	...	...	....	....	....	....
Rubber	...	...	2	3	...	...	1	...	2	1	3	...	...	....	1	1	....
Totals for all industries in Massachusetts	29	2	59	123	1	2	2	4	35	5	117	1	11	1	6	7	1

estimated as 1,606,105,000 kw.-hr., of which 633,435,000 kw.-hr., or 39.4 per cent, was generated in private stations. There are 1,109 electric generators installed in the private generating plants, with a total rating of 469,736 kw., of which machines rated at 431,843 kw. are alternating-current generators. By far the largest user of industrial energy in Massachusetts is the textile industry, which in 1920 consumed 657,500,000 kw.-hr., or 40.9 per cent of the total energy consumed for power purposes. Almost 53 per cent of the energy consumed by this industry is generated in private plants. The paper and printing industry is the second largest consumer of industrial energy.

There are 117,038 motors installed in the plants of the state, of which 58,127 are under 5 hp. The total rating of all the installed motors is estmated at 1,206,593 hp. About 72 per cent of the motors are belt-driven, 22 per cent are directly connected and 6 per cent are chain-driven. Over one-third of the total number of motors are installed in the textile mills of the state.

The returns indicate that nine voltages are in use in Massachusetts mills and factories for the operation of direct-current motors and that seventeen voltages are used in the operation of alternating-current motors. These figures indicate that a large field is open to the electrical engineers of the state in the matter of voltage standardization. It appears, however, that voltage standardization has played a much greater part in Massachusetts than in the intensely industrial state of Pennsylvania, where seventeen voltages are used for the operation of direct-current motors and twenty-one voltages are in use for the operation of alternating-current motors. The returns indicate that 35 per cent of the direct-current motors in Massachusetts are operated at 220 volts, but large percentages are also operated at 110 volts and 550 volts respectively. Iron and steel works particularly reported a high percentage of direct-current motors operated at 550 volts. More than 30 per cent of the alternating-current motors are operated at 220 volts, and almost 29 per cent are operated at 550 volts. The details of motor-operating voltages will be found in Tables IV and V.

Only fourteen companies reported the installation of motors with a rating of over 300 hp., and more than 37

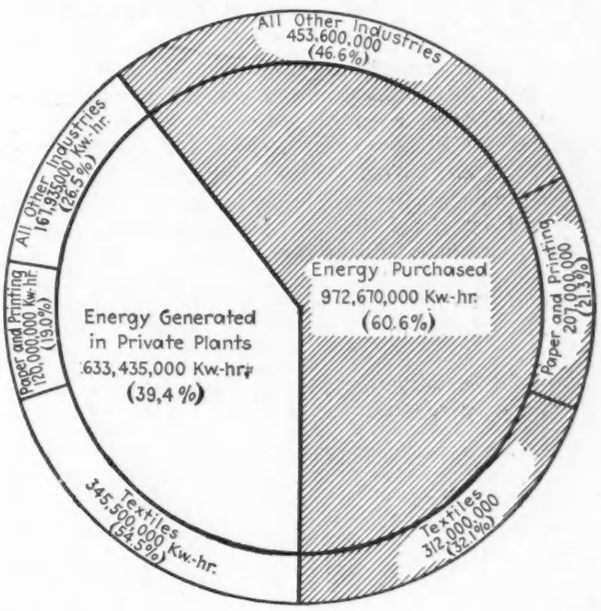


FIG. 3 — ALMOST TWO-THIRDS OF THE ENERGY CONSUMED BY THE INDUSTRIAL PLANTS OF MASSACHUSETTS IS GENERATED IN PUBLIC UTILITY STATIONS

per cent of the companies reported the largest motor as under 25 hp. About one-quarter of the companies reported that the smallest motor installed ranged between $\frac{1}{4}$ hp. and $\frac{1}{2}$ hp. Details on the size of the largest and smallest motors installed in the industrial plants of Massachusetts will be found in Table VI.

Almost 82 per cent of the companies reporting on

TABLE VI—SIZE OF LARGEST AND SMALLEST MOTORS INSTALLED IN INDUSTRIAL PLANTS OF MASSACHUSETTS

Industry	Largest Motor Installed (Number of Plants Reporting)						Smallest Motor Installed (Number of Plants Reporting)					
	Under 25 Hp.	From 26 to 50 Hp.	From 51 to 100 Hp.	From 101 to 200 Hp.	From 201 to 300 Hp.	Over 300 Hp.	Under ½ Hp.	From ¼ to ½ Hp.	From ½ to 1 Hp.	From 1 to 2 Hp.	From 2 to 3 Hp.	Over 3 Hp.
Chemicals	7	7	..	5	..	..	4	4	1	2	3	2
Electrical equipment and machinery	3	2	1	..	2	..	4	1	1	..	..	2
Food and kindred products	7	3	1	1	..	..	2	3	3	2	..	2
Iron and steel and their products	45	55	23	12	3	2	21	36	33	15	10	22
Leather and its products	22	6	3	3	1	..	5	10	8	4	2	6
Lumber and its products	6	10	3	..	..	..	..	8	3	3	..	5
Metals and metal products other than iron and steel	10	5	1	..	..	1	3	3	6	1	3	1
Paper and printing	11	1	8	11	6	5	6	14	6	3	6	4
Railroad repair shops	...	...	..	1	..	..	1	...	...	..	..	..
Shipbuilding	...	...	..	..	..	..	..	...	...	..	..	..
Stone, clay and glass	3	...	4	..	..	..	1	1	1	2	2	1
Textiles	60	52	31	20	3	..	19	37	37	16	17	38
Vehicles for land transportation	1	1	..	..	..	..	..	1	..	..	..	1
Miscellaneous	13	6	4	2	1	..	4	6	5	4	3	1
Rubber	1	3	2	..	1	6	6	1	3	1	..	1
Total for all industries of Massachusetts	189	151	81	55	17	14	76	125	107	53	46	86

TABLE VII—TYPES OF MOTOR CONTROL USED IN INDUSTRIAL PLANTS OF MASSACHUSETTS

Industry	No. of Companies Reporting on Motor Control	Number of Companies Reporting Various Types of Motor Control: Snap Switches	Knife or Safety Switches	Auto-Starters	Magnetic Switches	Remote Control	Circuit Breakers
Chemicals	16	3	9	9	1	4	7
Electrical equipment and machinery	8	5	5	7	2	2	3
Food and kindred products	9	3	8	6	6	2	4
Iron and steel and their products	129	31	125	72	33	20	72
Leather and its products	29	11	25	13	8	6	11
Lumber and its products	17	5	17	8	5	1	8
Metals and metal products other than iron and steel	16	2	13	7	2	0	9
Paper and printing	38	11	31	26	11	15	24
Railroad repair shops	1	1	1	1	0	1	0
Stone, clay and glass	4	1	3	1	2	1	0
Textiles	142	52	92	75	21	16	71
Vehicles for land transportation	2	1	2	0	0	0	1
Miscellaneous	20	6	18	10	7	0	12
Rubber	11	2	10	10	5	6	9
Totals for all industries in Mass.	442	134	359	245	103	74	231

TABLE VIII—FREQUENCIES USED IN INDUSTRIAL PLANTS OF MASSACHUSETTS

Industry	Total Number of Companies Reporting on Frequency	Number of Companies Reporting Various Frequencies Used (The first figure gives number of phases; the second figure the number of cycles.): 3–40	2–50	1–60	2–60	3–60
Chemicals	13	...	...	...	...	13
Electrical equipment and machinery	10	...	...	2	2	6
Food and kindred products	8	...	...	...	1	7
Iron and steel and their products	117	...	...	1	15	101
Leather and its products	23	...	...	...	2	21
Lumber and its products	14	1	...	...	1	12
Metals and metal products other than iron and steel	13	...	...	...	1	12
Paper and printing	39	1	1	...	3	34
Railroad repair shops	1	...	...	...	...	1
Stone, clay and glass	7	...	...	...	2	5
Textiles	137	4	...	5	5	123
Vehicles for land transportation	2	...	...	...	...	2
Miscellaneous	23	...	...	3	2	18
Rubber	15	...	...	2	1	12
Totals for all industries in Massachusetts	422	6	1	13	35	367

types of motor control use knife or safety switches exclusively or in conjunction with other types of motor control. Figures received from the other fourteen states which have been covered by the industrial survey of the ELECTRICAL WORLD indicate that 82 per cent is very close to the degree to which knife or safety switches are now used by the industrial establishments of the country as a whole. About 75 per cent of the plants use auto-starters and 52 per cent have installed circuit breakers. The detailed figures on types of motor control will be found in Table VII tabulated according to industry.

Standard fuses were reported in use by 173 out of 269 companies reporting on fuses, as against 158 companies using refillable and renewable fuses. These two figures are quite different from those reported by the industrial plants of Pennsylvania, where 477 out of 612 companies reporting use refillable and renewable fuses as against 196 companies using standard fuses. In Indiana 148 out of 169 companies use refillable and renewable fuses, while only 69 reported the use of standard fuses. It is estimated that 55,254 fuses of all types are used per month by all the plants in the aggregate.

Table X is an estimate of the total prime-mover equipment in the industrial plants of Massachusetts, and is based entirely upon the 1919 Census of Manufactures, figures on which have just been made available.

TABLE IX—TYPES OF FUSES USED IN INDUSTRIAL PLANTS OF MASSACHUSETTS

Industry	Total Number of Companies Reporting on Fuses	Standard Fuses: Number of Companies Using This Type	Fuses Used per Month: Number	Number per Motor	Refillable and Renewable Fuses: Number of Companies Using This Type	Fuses Used per Month: Number	Number per Motor	ELECTRICAL WORLD Estimate of Fuses Used per Month by All Industrial Plants in Massachusetts: Standard	Renewable and Refillable
Chemicals	6	6	207	1.592	3	112	0.308	821	446
Electrical equipment and machinery	6	4	5,720	0.633	1	50	0.477	13,445	134
Food and kindred products	8	3	160	0.508	6	332	0.454	777	1,621
Iron and steel and their products	89	59	1,724	0.688	54	1,417	0.549	4,414	3,637
Leather and its products	18	10	235	0.417	13	112	0.157	2,258	1,078
Lumber and its products	12	6	69	0.657	10	132	0.583	507	969
Metals and metal products other than iron and steel	10	8	61	0.598	3	151	1.937	643	1,598
Paper and printing	23	17	671	0.362	10	86	0.460	2,261	291
Railroad repair shops	1	1	100	0.935	1	100	0.935	251	251
Stone, clay and glass	1	1	201	0.841	1	512	0.516	466	1,187
Textiles	78	44	598	0.142	42	784	0.238	2,900	3,680
Vehicles for land transportation	2	2	12	0.923	1	12	0.857	293	291
Miscellaneous	8	7	119	0.869	9	361	1.472	2,295	6,920
Rubber	7	5	282	0.255	4	302	0.513	880	940
Totals for all industries in Massachusetts	269	173	10,159	0.504	158	4,363	0.472	32,211	23,043

TABLE X—"ELECTRICAL WORLD" ESTIMATE OF TOTAL PRIME MOVER EQUIPMENT IN INDUSTRIAL PLANTS OF MASSACHUSETTS

Industry	Total Power of All Kinds in Industrial Plants Including Private Electric Generating Stations: Hp.	Steam Engines: No.	Hp.	Steam Turbines: No.	Hp.	Internal Combustion Engines: No.	Hp.	Waterwheels: No.	Hp.	Boilers: No.	Hp.
Chemicals	28,043	65	9,060	16	3,225	20	392	3	186	146	21,200
Electrical equipment and machinery	38,088	8	3,925	6	24,718	1	75	2	180	27	11,650
Food and kindred products	64,030	104	25,902	5	1,718	11	1,047	17	2,063	137	37,050
Iron and steel and their products	207,443	264	62,924	37	10,840	10	2,324	59	6,755	493	98,200
Leather and its products	97,502	165	33,183	3	9,200	2	268	5	551	143	31,150
Lumber and its products	58,332	231	32,772	2	318	9	1,726	79	5,786	248	38,650
Metals and metal products other than iron and steel	42,474	39	10,084	2	260	5	403	8	727	45	7,310
Paper and printing	226,399	157	63,794	28	29,600	3	377	155	62,228	330	98,500
Railroad repair shops	15,159	12	7,753	8	1,000	1	6	.....	.....	28	7,220
Shipbuilding	2,304	2	653	...	...	2	251	.....	.....	3	750
Stone, clay and glass	40,000	78	13,186	5	5,853	7	431	4	780	82	20,250
Textiles	861,548	1,033	371,092	154	177,513	17	5,453	649	104,290	2,150	515,000
Vehicles for land transportation	12,805	13	2,417	1	275	2	235	4	408	18	5,170
Miscellaneous	124,696	266	41,677	35	15,329	6	1,182	107	15,408	429	78,700
Rubber	81,644	82	16,107	31	11,640	1	57	9	940	97	37,500
Totals for all industries of Massachusetts	1,900,467	2,519	694,529	333	291,489	97	14,227	1,101	200,302	4,376	1,008,300

Oil Qualities Desirable for Transformers and Circuit Breakers

Explosive Limits, Dielectric Strengths and Sludging Properties Are Particularly Important—A Study of the Practical and Theoretical Behavior of Oils Under Service Conditions

By C. J. RODMAN
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THE busy engineer with a dozen irons in the fire has little time to ask about the important problems of mineral-oil insulation and their solution. Neither can he usually carry on scientific investigations which would reveal the characteristics desirable in such oils when they are applied to his needs. Still, he desires to have an oil which will best suit his electrical application at the lowest cost commensurate with safety in operation, durability in composition and freedom from contamination by contact. The following is intended to meet this need:

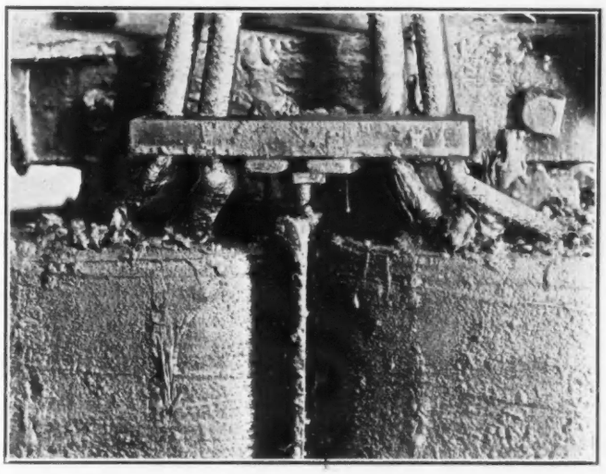
When mineral oils are subjected to the action of an electrical discharge, such as occurs in circuit breakers, even the most stable oils are broken down into decomposition products which consist of some amorphous elemental carbon, a small amount of liquid hydrocarbons, either saturated or unsaturated, and a proportionately large volume of gas, of which hydrogen represents 60 to 70 per cent. If air is added to these combustible constituents in deficient or excessive quantities an explosion cannot occur. Thus each combustible gas or mixture of combustible gases with air or oxygen possesses a lower and an upper explosive limit.

Conditions Most Severe in Circuit Breakers

The fire and explosive hazard of insulating oils connected with circuit breakers is apparently greater than with the transformers and is due primarily to the violent agitation and disruption of the oil during the circuit-breaking period. The gases and vapors which are quickly forced to the surface mix with the atmosphere in the space above the oil. Laboratory tests have shown that similar gas mixtures may be spontaneously ignited at a temperature as low as 270 deg. C. Such cases are exceptional, the general ignition temperature for an average explosive mixture of this character being above 550 deg. C. Hence the ventilating ducts or pressure valves which admit air into the head of the circuit breakers should be removed. An outlet for the disrupted oil gas and vapor should be installed which would prevent fine oil spray from entering the air at more than the flash-point value of the insulating liquid used. The recent successful use of a muffler device for this purpose permits rupturing greater loads in the same oil with greater safety.

It is not within the scope of this paper to discuss the mechanism of discharge rupture of oils, but it may be briefly stated that the amount of gas liberated per kilowatt-second of arc energy decreases with a rise of molecular weight of a homologous series. A research on the high-frequency disruption indicates that rupture of oils per kilowatt-second follows a fairly well defined law.

A great number of vegetable oils when pure possess very good insulating properties. Their initial state of purity is maintained only with extreme care in connection with their use in electrical apparatus. These oils are chemically unstable and have structural formula of unsaturated linkages admitting of drying (oxidation) and formation of saponifiable products, giving rise to the highly undesirable property of formation of ad-



SLUDGE FROM POOR TRANSFORMER OIL AFFECTS THE INSULATING PROPERTIES OF THE WINDING AND REDUCES THE HEAT CONDUCTION

herent sludges, with simultaneous reaction products of a much lower dielectric strength. Granting that the chemically pure vegetable oil would undergo no decomposition while in use, other undesirable properties, such as high viscosity, volatility, drying and comparatively high affinity for water, would make their use somewhat difficult.

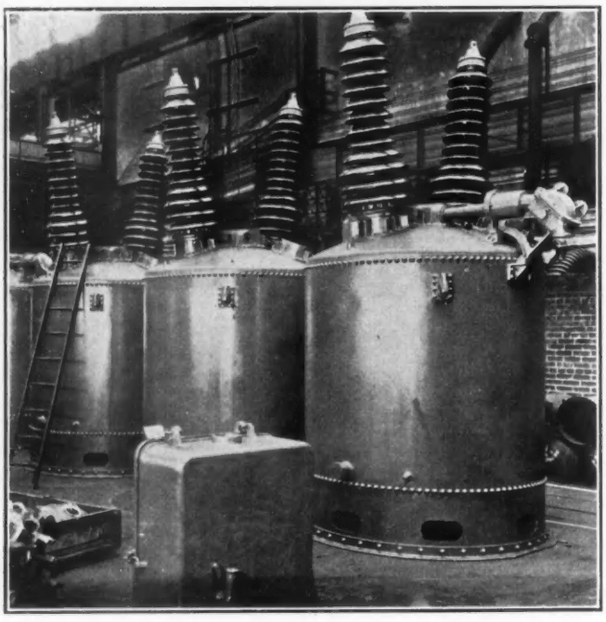
Distillates obtained from the destructive distillation of coal contain substances which are chemically more active than the saturated mineral oils. However, benzol, tuluol, xylol, or the halogenated derivatives, possess a fair insulating value and can be used in some special applications. The action of these compounds limits their use to apparatus built of insoluble metal and insulation. If used within the oil switch or circuit breaker, such compounds are decomposed, resulting in a medium of much lower dielectric strength. Other properties such as volatility, water solubility, fire hazard, etc., limit their use.

A chemical specification which defines a good transformer oil is that it be of pure mineral oil conforming to the formula C_nH_{2n+2} (the paraffines) and $C_nH_{2n} = C_nH_{2n-6} + 6$ (the naphthenes) where n equals 12 to 18.

The fluidity, the flash, fire and boiling points, dielectric strength, etc., have a certain value dependent upon the value of n. An oil defined by this formula excludes harmful impurities, such as water, sulphur and nitrogen derivatives, unsaturated and oxidizable compounds, acid or alkali and various forms of dirt and suspended or dissolved materials. In general, the flash, fire, freezing and boiling points, viscosity and dielectric strength increase with a rise in molecular weight. Other physical and chemical properties bear a definite relationship to the ascending or descending series.

APPLYING KNOWLEDGE IN SELECTING OILS

Knowing the dielectric strength of the oil, which varies slightly with a change of n, the conducting members of the electrical apparatus are properly spaced by the designer. It is desirable that the operation temperature of the transformer be kept as low as possible. Hence the correct heat capacity for proper cooling will be largely determined by the viscosity and the specific heat



EACH OF THE TANKS FOR THESE BREAKERS CONTAINS OVER 9,000 GAL. OF OIL

of the oil. Since heating takes place within the central parts of active members of the transformer, the rates of convection currents for heat interchange are largely dependent upon the fluidity of the oil. The ambient temperature of the transformer, whether in hot or cool climates, will also govern the selection of a suitable oil. For cold climates the value of n should decrease, thus lowering the pour and cloud tests. Under heavy operation the oil may overheat, hence excessive volatile constituents in the oil must be avoided. It is only by a close scrutiny of operating conditions that the best oil available may be selected.

The life of a mineral oil is intimately connected with the formation of deposits known as sludge. Oils obtained from the same shipment which have been placed in transformers and have had similar treatment may differ much in their sludging characteristics. Some oils go bad after a year or two, while others with the proper care function well after twenty years of service. Some oils will deposit adherent sludge upon the core, while others deposit sludge upon the cooling coils or at the bottom of the tank. The nature of these sludging phenomena are generally threefold, namely, (1) the formation of sludge due to oxidation, (2) the reaction of liberated characteristic organic acids with certain metals to form soaps, and (3) the actual deposition of carbonaceous material due to electrical breakdown.

The formation of sludge by oxidation of attackable oil with atmospheric oxygen is by far the most general case. This sludge gradually forms within the oil and tends to become deposited upon the warmest parts of the transformer in an adherent honeycombed form. The interstices or pores of this deposit become filled with loosely formed and finely divided precipitated sludge. By breaking off a piece of this adherent sludge and giving it a subsequent extraction with naphtha to free it from oil and loose deposit, a brown, porous, well-defined structure is obtained, which becomes brittle after allowing it to dry. Examination of this form of deposit indicates an asphaltic compound rich in oxygen, which possesses no free carbon, though at times it may appear quite black. Transformer oil dissolves 10 to 18 per cent of oxygen by volume, depending upon the temperature. Thus, when oil is in contact with air, a constant source of oxygen is available to assist in the formation of sludge. Local hot spots, the presence of unsaturated compounds and oxygen are the chief causes of the formation of asphaltic sludge.

A sludge of the second type may be deposited with

TABLE I—EFFECT OF ELECTRICAL DISCHARGE ON GAS CONSTITUENTS

CO^2	Unsaturated Gases	O^2	CO	H^2	CH^4	N^2
0.85	22.38	2.11	.80	65.60	2.36	5.60
0.24	19.05	2.38	.24	68.25	3.81	6.18

the asphaltic sludge on the sides of the coils, at the bottom of the tank or upon the cooling coils. The formation of this kind of sludge depends upon the liberation of acids ($C_nH_{2n-2}O_2$ and $C_nH_{2n}O_2$) by slow oil decomposition and their interaction with metals or oxides to form soaps. Such sludge appears dark brown to white in color. Small particles of this sludge aid greatly in raising the moisture content of the oil which is generally condensed from humid air during "breathing." An approximate analysis of this kind of sludge gave 96.6 per cent water and 3.4 per cent dried sediment. The latter consisted of 11.3 per cent Fe_2O_3, 1.4 per cent CaO, 4.1 per cent MgO, 13 per cent of Na salts and 70 per cent of H_2O, and organic material. The asphaltic type of sludge has a much higher insulation value than does soap sludge. In either case the presence of a deposit within the oil should warrant immediate treatment, such as filtration through a filter press containing blotting paper and a leaf or so of finely divided calcium oxide to remove solids, water and acids. Centrifugation in a specially designed centrifuge gives an oil free from many undesirable constituents. Clean, pure mineral oil dissolves less than 0.003 of 1 per cent of water.

A third type of sludge which is distinctly characteristic of electrical breakdown may be present in transformer oil. Corona discharge, or arcing within the oil, breaks down the oil to amorphous carbon, to saturated and unsaturated members lower in the series, and to various gases consisting mostly of H_2 (60 per cent), unsaturated gases (20 per cent), CH_4, CO, CO_2 and N_2. High voltage and low current discharge gives very

finely divided carbon, whereas low voltage and high current produces comparatively large particles of carbon sludge. The finely divided sludge or precipitate is nearly pure amorphous carbon having a high specific resistance. The coarser precipitate contains much free carbon with small amounts of hydrocarbons low in hydrogen. Its specific resistance is lower than amorphous carbon. No graphite carbon was found as a result of electrical breakdown within the oil. However, if an arc plays near the surface of the oil where atmospheric oxygen is present, "graphitoidal" carbon is formed. This form or these forms of carbon are more conducting than amorphous carbon and lie somewhere in the series between the amorphous and graphitic carbons.

Standard textbooks, government and various companies' specifications, as well as methods prescribed by societies (A. S. T. M.), discuss and designate such tests of oils as boiling point, flash and fire points, cloud and pour tests, evaporation, viscosity, dielectric strength and the determination of sulphur, acid and alkali. Other tests, such as moisture content, volatility and deposit or sludging tendency, need special revision in order that they may be intelligently applied to insulation oils. At the present time considerable activity along this line indicates that ere long complete reliable standard methods covering insulation oil will be forthcoming.

MINERAL OIL VAPORS ARE NOT EXPLOSIVE

Owing to the inflammability of the lower members of the paraffine series, the general impression exists that all mineral oils carry with them some sort of spontaneous ignition hazard. Such a view is unwarranted. It is true that manufacturers of electrical equipment specify as high a flash and fire point as is commensurate with proper fluidity, which insures the oil against any mixture of lighter volatile constituents, but with a flash point above 140 deg. C. the vapor pressure of the oil is so low—namely, less than 2 mm.—at normal operating temperatures, that the possibility of creating an explosive mixture is indeed remote. A great many tests in which the atmosphere above transformer oils was subjected to the effect of corona or spark discharge indicated the existence of a non-explosive mixture.

By subjecting the oil to the action of electrical discharge, either by corona or by high-frequency or low-frequency arcing, the oil is broken up into a number of decomposition products, such as solids, liquids and gases. The solid or sludge products remain in the oil, usually settling to the bottom. The dielectric strength of such products is comparatively high. Much has been said about the alignment of particles within an oil to produce a much lower insulation value under the stress of an electrical field. The following experiment does not substantiate this view. After arcing an oil for some time by means of high-frequency discharge an oil was produced which contained a large quantity of small carbon particles in suspension. The breakdown strength of the altered oil was still well above specification. These decomposition products should not be confused with fibers which do lower the breakdown strength of an oil, chiefly because their chemical nature is such that water is greatly attracted to them instead of being dissolved within the oil, thus forming a bridge for conduction. The liquid breakdown products are either saturated or unsaturated hydrocarbons lower in the series.

With proper design of apparatus and the selection of an oil which is inspected from time to time, no breakdown of the transformer should ever occur under normal operation. Should a breakdown occur, it is of interest to note from the composition of gaseous breakdown products that the explosive limits of a mixture of this disrupted oil gas with air is rather wide, namely, between 2.5 and 72 per cent. Thus if an air space exists above the oil in the top of the tank, this air when mixed with the disrupted oil gas will exist as a serious potential explosive mixture and fire hazard. This fire hazard may be lessened by introducing into the top of the tank an inert dry atmosphere of permanent gases. Atmospheric nitrogen or carbon dioxide may be used. If it becomes necessary to use an impure oil containing some unsaturated constituents, a great reduction in sludging will occur if the atmospheric oxygen is displaced. The fire hazard connected with disrupted mineral oil from circuit breakers should not confuse one concerning the high safety factor that attends transformer operation. By recent installation of the muffler device on circuit breakers not only is the steep pressure wave gradient very materially reduced, but the disrupted gases are so taken care of that explosions following the clearing of the breaker are next to impossible. Thus greater currents are now ruptured with smaller breakers while still using the same insulating oil.

TABLE II—EXPLOSIVE LIMITS OF OIL GAS CONSTITUENTS

	Lower Limit	Upper
CH^4 and air—1876 to 1921—average of twelve investigators	5.4	13.7
Coal, gas and air—1869 to 1921—average of eight investigators	5.9	24.0
H^2 and air—1876 to 1921—average of nine investigators	7.9	69.4
H^2 and O^2—1834 to 1921—average of five investigators	8.3	93.5
C^2H^2—air—1896 to 1921—average of five investigators	2.8	65.9
CO and air—1891 to 1921—average of four investigators	15.3	74.9
Water-gas—air—1894 to 1921—average of two investigators	9.0	60.8
Natural gas—air—1896 to 1921—average of one investigator	5.0	12.0
Ethane-air—1896 to 1921—average of one investigator	2.5	5.0
Ethylene-air—1896 to 1921—average of one investigator	4.0	22.0
Gasoline vapor and air—1896 to 1921—average of one investigator	1.5	6.0
Artificial and illuminating gas-air—1896 to 1921—one investigator	7.0	21.0
Blast-furnace gas and air—1896 to 1921—one investigator	36.0	65.0
Ethene and air—1896 to 1921—one investigator	4.0	22.0
Transformer-oil vapor and air—1920 to 1921—one investigator	2.5	8.0
Disrupted oil gas in air—average of three investigators	2.5	72.0
Atmosphere above oil in operating normal transformer	No explosive limit	

The paraffins and naphthenes of certain fractional cuts from petroleum crudes, when not mixed with impurities which might seriously affect the electrical insulating qualities, should function properly in a transformer for years. It is desirable that the color of the oil should be as light as possible and that it should be free from sulphur, moisture, acid or alkali. The oil should be practically odorless at room temperature and possess a volatility less than 0.003 gram per hour per square centimeter of surface area exposed at 100 deg. C. A good transformer oil should have a viscosity below 50 Saybolt seconds at 40 deg. C. At this viscosity and a specific heat approximately 0.520 good cooling of the transformer is assured. The flash and fire points as recorded by the Cleveland open-cup method should be 140 deg. C. and 156 deg. C. respectively. The insulation value when tested at 0.1-in. (2.5-mm.) gap separation of parallel disk electrodes should be above 25 kv. A well-refined oil sometimes reaches a value over 40 kv., the general average being around 30 kv. A boiling point (A. S. T. M. D-28) of 240 deg. C., a cloud test of 0 deg. C., a pour test of — 3 deg. C. and a deposit test of less than 4 grams as formolit are desirable properties of an insulating oil for transformer purposes.

Letters from Our Readers

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

An Odd Case of Underground Current Drainage

To the Editors of the ELECTRICAL WORLD:

In the Feb. 18 issue of the ELECTRICAL WORLD (page 335) there is a communication from Dr. Carl Hering which bears the above caption. It is the writer's belief that the conditions set forth are by no means unusual but that they could be found on nearly every large electric railway system where there are a number of power stations or substations situated fairly close to each other and all feeding into a network of lines so that each station is connected electrically, through its feeders and the trolley wire, with one or more of the other stations. That such conditions have not been noticed and commented upon more frequently is due first to the fact that indicating or recording instruments are very seldom placed in the returns to the busbars, and second to the fact that, although many men have noticed that current sometimes leaves the bus over the cable sheaths or pipes, most of these men have been station attendants or others with little technical training and have therefore not given the matter the same careful, analytical thought that Dr. Hering did—or, at any rate, have never written on the subject.

Dr. Hering's explanation of the cause of the current returning as it does is undoubtedly correct, but could not his statement be simplified by merely considering that both stations fed into the same general territory and that the return path to station B through the rails and ground connections into station A and thence over the drainage cable and pipes to station B was low enough to cause a small portion of the current to come back to the latter station in that way instead of it all following a single path?

It is well understood that the ground potential of large cities will vary by several volts, depending upon the locality where the readings are taken, and pressure wires connecting the negative buses of a number of stations situated in the same area will show similar differences of potential.

The writer does not follow the line of reasoning advanced by Dr. Hering that would call for the current to leave the negative bus of the station having the higher positive voltage and flow to one having a lower voltage, and still make it appear odd when the opposite condition is found. Increasing the voltage on the generators or rotaries will make very little difference in the ground potential of the negative bus, and this is the condition that causes the current to flow, while the increased load which will be picked up by the station having the higher voltage will come from territory normally fed from some other station, and therefore make it more likely that the grounds through the other station will be used as a part of the return to the station supplying most of the current.

Westfield, N. J. G. H. MCKELWAY.

Reply to Mr. McKelway

To the Editors of the ELECTRICAL WORLD:

The first part of the last paragraph of Mr. McKelway's comment is without foundation of fact, as it will be seen by reading my little article that there was no such "line of reasoning" anywhere in it. I merely referred to the incident as an "apparent anomaly"; Mr. McKelway sets up a straw man in order to knock him down. That it was "odd" and "unexpected" to find a drainage current flowing to an underground pipe *from* the negative bus has been and will be admitted by many, hence those terms are justified. After explaining that it was caused by an unsuspected second distant power station it is easy to understand.

The "ground potential" is a very convenient "goat" on which to blame all sorts of anomalies that we may not understand. One is generally safe to make a goat of the ground, as it is often difficult to prove the blame misplaced. But that Mr. McKelway's proposed explanation, that the "ground potential" is "the condition that causes the current," is not correct should be shown by the fact that if the whole system, including the pipes, were perfectly insulated from the ground, the result would be the same, the insulation between the nails and the pipes being made a leaky one, as in the actual case, or an actual metallic resistance. CARL HERING.

Philadelphia, Pa.

Invites Operators' Suggestions for Improving Automatic Stations

To the Editors of the ELECTRICAL WORLD:

The May 20 issue of the ELECTRICAL WORLD contains a research reference to automatic substations which is of interest to us. On page 1039 of that issue the statement is made that "it is desired to develop a control system which will keep revolving machinery in automatic stations running, unless the period of light load is of considerable duration."

Automatic stations with revolving machinery are now being supplied to cover a very wide variety of conditions. These stations are provided with devices which keep the machinery operating for any period up to twenty-five minutes, should the light load last that long. Developments now in progress promise devices which will permit this time to be lengthened materially.

There is another aspect to the matter, however, which indicates that the revolving machinery consumes more energy during its light load running than is desirable. Tests of a number of automatic stations which have been in service several years indicate that the amount of energy consumed in starting rotary converters and the like and placing them in condition to deliver power amounts to the light-load running loss for two minutes.

Another aspect is that after five years' operation there is no appreciable depreciation of apparatus due to frequent starting and stopping in automatic station operation.

There may be, however, a number of features which our studies have not indicated and which have prompted the suggestion for research mentioned. I shall therefore very much appreciate it if those interested will make known such information as they may have tending to indicate the direction in which reasearch should be directed in order to meet the requirements met with in the course of actual operation.

General Electric Company, CHESTER LICHTENBERG.
Schenectady, N. Y.

Industrial and Station Practice

Installation, Operation and Maintenance of
Generating and Distribution Equipment and Economical Utilization of Electrical Energy
in Mills and Factories, Including Testing and Repair Methods

Jewel Inspection Essential for Proper Meter Operation

THE care and inspection of jewels and pivots, while an important subject to the meter manufacturer, should be equally important to the central-station meter department. No great technical skill is required to determine the condition of a polished surface inside the cup jewel. An ordinary sewing needle is all that is required to make the necessary inspection, although a binocular microscope of a magnifying power from eight to ten diameters is very helpful in determining the exact nature of imperfections. To examine the jewel, the lower bearing should be grasped with the jewel between the fingertips of one hand, while the needle is held between the fingertips of the other hand. The needle point should now be brought in contact with the jewel and receive a very irregular motion in all directions. It requires only a little practice for the fingertips to respond to the slightest friction encountered by the needle. A surface that is satisfactory should be entirely free from irregularities or scratches. The binoculars, however, will serve to determine the nature of the polishing and will detect the presence of striæ coming into the polished surface which are not so readily detected by means of the needle. Small ripples or irregular surfaces may be allowable if they are out of range of the pivot, but only some one skilled in the selection should be trusted in these determinations.

The large number of jewel failures in service is not the fault of the jewels themselves, but arises from the lubrication and action of the lower pivot. Because of these failures lower bearings are often returned for repolishing, which is sometimes done without removing the stone from its setting. This practice is, however, a questionable one, since it involves the chance of particles of sapphire or diamond clinging to the mounting and after a time getting into the cup and causing great damage. In repolishing without actually removing the stone from its setting every precaution must be taken to clean the mounting and stone after the process is completed.

The question as to the right material to be used for the lower pivot is a hard one to answer. Many materials have been tried. Any material that has the property of extreme hardness and homogeneity and is capable of taking a high polish might be satisfactory; but steel, though it has been universally employed, is by no means entirely satisfactory. Stainless steels, unfortunately, cannot be sufficiently hardened, but the semi-stainless steels, such as chrome or tungsten, have great promise.

The inspection of the lower pivots should be carried out under a binocular microscope. The pivot should show a distinctly spherical surface at the point where it comes in contact with the cup, and the polish should be very high. This pivot should have a radius of curvature such that the material will not yield under the enormous pressures that are present. If there is any doubt as to the hardness of the pivot, it may be tested approximately by means of a jeweler's file. The pivot in proper condition should resist filing to a degree which indicates that the file is not taking hold. Such tests, however, will injure the particular pivot tested by this method to such an extent that it cannot be used in a meter.

F. C. HOLTZ,
Chief Engineer.
Sangamo Electric Company,
Springfield, Ill.

Improved Design of Heavy-Duty 6,600-Volt Double Bus

THE design of a modern heavy-duty bus is less an electrical problem than it is a mechanical one. Simplicity of design, reliability in operation, ease of maintenance and safety under short-circuit stresses are to be striven for in every large central station.

Special effort has been made in replacing a single bus with a double bus at the Bennings power station of the Potomac Electric Power Company, Washington, D. C., to design the structure, supports and copper so as to withstand the theoretical stresses that may occur under short-circuit conditions in a station of 93,000-kw. capacity. Limitations caused by existing wall and floor and by restrictions in width of electrical bay have not prevented attaining practically all desirable features of the modern bus.

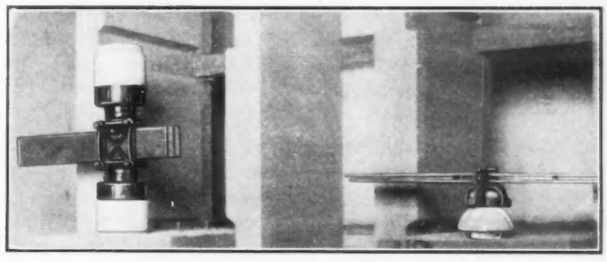


FIG. 1—ADJUSTABLE CAP PERMITS EASY ALIGNMENT AND REPLACEMENT OF INSULATOR

The several features of the bus, as indicated in Fig. 2, where a typical section and elevation are shown at the left, with the details of the bus support at the right, are:

1. Busbars are totally inclosed (except for inspection holes), with isolation barriers between phase leads.
2. There are large clearances between phases and to sides of compartments.
3. Individual copper bars of bus are placed vertically so as to transmit with a minimum deflection short-circuit stresses to the bus supports.
4. Bus supports of all buses are arranged in a single column, instead of being staggered, with short-

circuit stresses transmitted through the supporting slabs to the building structure.

5. Upper bus supports are restrained by a steel clamp, to resist upward short-circuit stresses.

6. Heavy-duty, straight-sided porcelains are cemented into supporting slabs, above and below, resulting in simple installation and in maximum resistance to side stresses upon short circuit.

7. Bus supports are adjustable, to facilitate alignment and replacements of porcelains.

The holes in the precast slabs were made by using clay cores molded to proper shape. In the installation of the bus supports neat cement was allowed to fill completely the central hole of the upper porcelains and to fill the upper porcelain as far as it would squeeze upward.

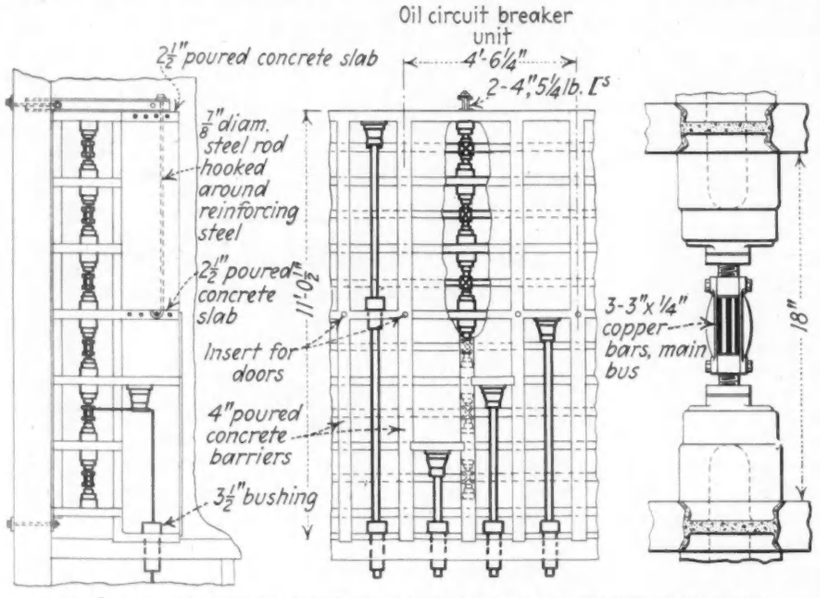


FIG. 2—BUS PORCELAINS CEMENTED TO SUPPORTING SLABS OFFER MAXIMUM RESISTANCE TO SHORT-CIRCUIT STRESSES

Left and Center—Typical section and elevation views of heavy duty bus. Right—Details of bus support showing method of cementing porcelains to concrete slab.

The bus-support unit consists of two straight-side insulators, cemented above and below into horizontal concrete barriers between buses. Supports for all buses line up vertically to form a column of twelve porcelains in the double-bus construction employed. The cap of each porcelain, as shown in Fig. 1, is provided with an adjustable head for aligning the copper bars and to facilitate replacement of defective insulators.

The principal dimensions of the bus support are as follows:

Center 3-in. x ¼-in. bus to top or bottom slab, in.	9
Leakage distance on straight sides, in.	3½
Diameter of porcelain, in.	5 7/16

The units were required to pass the following tests:

Porcelain, before assembly, volts	45,000
Assembled units, volts	35,000
Compressive or tensile strength of unit on vertical axis, lb.	2,500
Cantilever strength of unit applied at the clamp at right angles to vertical center line, lb.	2,000

The test results showed a proper margin of safety above the requirements of the specification.

Stone & Webster, Inc., W. R. McCANN.
Boston, Mass.

Considerations for the Construction of Rural Distribution Lines

THE average amount of distribution system equipment per rural customer is from five to ten times the average amount per city customer according to data obtained by the overhead-systems committee and presented in the annual report at the recent N. E. L. A. Convention at Atlantic City. Furthermore, rural lines are usually built along roads which may be in poor condition during certain parts of the year and particularly so immediately after severe storms. It usually requires a considerable amount of time and money to make even a very minor repair to rural line or transformer installation, and it is therefore important to design these lines so that, while the initial cost is kept as low as possible, no construction will be used which will increase maintenance and operating costs.

There are several factors to take into consideration in the construction of rural lines, some of which are given in the following paragraphs:

Poles.—In selecting the size of poles for rural lines consideration should be given to two things: First, the diameter of the pole at the top and ground line. Owing to the fact that poles in rural lines seldom support more than three wires, a pole with a comparatively small diameter may have sufficient strength, when new, to withstand the strains put upon it. Poles with a small diameter, however, have a very limited life, and their strength decreases much more rapidly than that of larger poles. Maintenance costs will consequently increase materially, and it will be cheaper in the end to use a substantial pole in such lines.

The second point to consider is the height of the pole. Rural lines are usually located along a highway and therefore must cross other public highways and cross over numerous driveways into farm yards and fields. In making these crossings it is necessary for the wires to be held at a substantial height above the drives, and therefore poles of a definite minimum height are required. Shorter poles may be used between these drives, but unless proper grading is followed, a very unsightly line is the result. Furthermore, if the line is so built that only minimum clearances above ground are maintained at all points, it will be necessary to increase the height of several poles whenever a new driveway is made or an old location changed. The additional cost of the higher poles will very often be exceeded through such changes. It has been the experience of a number of companies that it is cheaper and better to build a line with comparatively long spans supported on substantial poles than to use short spans and short poles. Careful consideration should be given to the question of poles before selecting a pole less than 30 ft. long or with a top diameter of less than 6 in.

Transformers and Lightning Arresters.—Transformers should be of standard type and make and protected with proper types of fuse blocks and fuses. In all districts affected by lightning the transformers should be further protected with lightning arresters. It has been found that in most farm lines now built the transformers are much larger than necessary. This greatly increases the transformer loss and adds materially to the cost of rural service.

Insulators.—Inasmuch as it costs a considerable amount of money to replace a broken insulator on a rural line, owing largely to transportation costs, it is very desirable that insulator failures should be reduced to a minimum.

It has been found that it is cheaper in the end to equip the line with insulators designed for a somewhat higher voltage than the line voltage. Insulators may be either porcelain or glass, depending on voltage and climatic conditions. Porcelain strain insulators should be used where strain insulators are necessary.

Conductors.—In general the conductors should be either copper, steel, reinforced aluminum or copper-clad steel.

MINIMUM VALUES FOR MATERIAL AND CONSTRUCTION FOR RURAL-SUPPLY LINES IN HEAVY LOADING DISTRICTS.*

	Span, Ft.				
	125	150	175	200	250
Wire:					
Medium hard-drawn copper (No.)	8	8	6	4	4
Aluminum steel reinforced (No.)	6	6	4	4	4
Copper-clad steel (No.)	10	10	8	6	6
Pin spacing† (in.)	12	12	15	18	26
Sag for medium hard-drawn copper (in.):					
30 deg. Fahr.	11	22	28	32	64
60 deg. Fahr.	18	27	33	38	71
90 deg. Fahr.	22	32	39	45	77

* In each case the cross-arm recommended is 3½ in. x 4½ in. Yellow pine or fir.
† To the pin space for spans of 125 ft. and 150 ft. add 0.4 in. for each 1,000 volts between phases above 7,500 volts. For the others add 0.2 in. for each 1,000 volts above 7,500 volts.

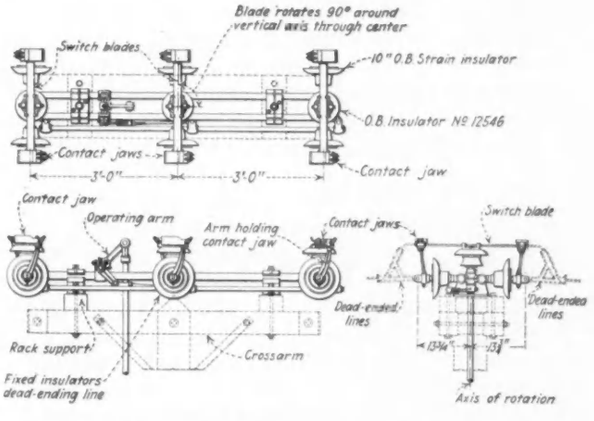
There may be instances wherein steel strand or iron wire can be used to advantage; however, owing to low conductivity and comparatively short life, these are not usually recommended for general rural-line construction, particularly where increased loads may later be expected.

The accompanying table gives the wire size, pin spacing and sag for various spans for rural lines as recommended by the National Electrical Safety Code.

New York, N. Y. FIELD EDITOR ELECTRICAL WORLD.

Rotary Switch Operates Satisfactorily on 17,000-Volt Line

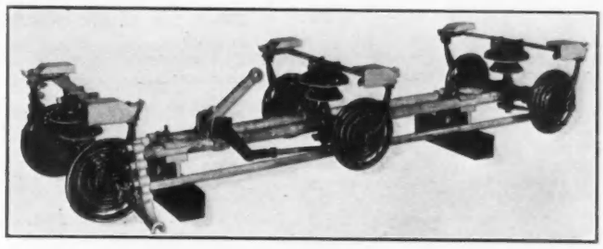
A RUGGED 17,000-volt rotary switch of the strain type for double cross-arm mounting has been employed successfully by this company in order that it might meet the demands of the increased use of outdoor equipment. At first it was thought that trouble would develop on the end insulators owing to the torsional moment of the blade engaging the stationary contacts.



SWITCH BLADES ROTATE ON VERTICAL AXIS TO OPEN 17,000-VOLT LINE

From the fact that more than a hundred switches of this type have been giving satisfactory service for several years it is evident that no destructive stresses are set up in the insulator supports or attachments.

The rotary switch rack is made up of 1¼-in. wrought-iron pipes bolted rigidly to two supports that are in turn fastened to the double cross-arms as shown in the accompanying illustrations. A lever at the foot of the pole operates the blades by turning the center insulators through an angle of 90 deg. on a vertical axis. The line is dead-ended on strain-type insulators which constitute the end insulators of the switch. To these are fastened the jaws into which the rotating blade engages. The entire switching equipment weighs approximately 325 lb.



TYPE OF ROTARY SWITCH SUCCESSFULLY USED ON 17,000-VOLT TRANSMISSION LINE

PAUL P. ASHWORTH,
Utah Power & Light Company, Distribution Engineer.
Salt Lake City, Utah.

Cost of 33,000-Volt Transmission Line Is $1,757 per Mile

A 33,000-VOLT, three-phase, 60-cycle transmission line was built recently by the Wabash Valley Electric Company of Clinton, Ind., at $1,757 per mile, not including the cost of a 33,000-volt substation with its metering equipment. The overhead expense, including engineering, general office salaries, legal expense, injuries and damages, insurance, taxes and interest, was also excluded. Hitherto the Roachdale (Ind.) Electric Company, which operated 45 miles of transmission line serving some nine communities, has generated its own power at steam plants at Roachdale and Lagoda. Under a contract with the Wabash Valley Electric Company its present Clinton-Greencastle line was extended from Greencastle to Bainbridge, a distance of 11 miles, and a switching, transformer and metering station was established from which the Roachdale Electric Company takes its energy supply. The costs shown in the table on page 1278 are for the 11 miles of line which the Wabash Valley Electric Company placed under construction on Nov. 25, 1921, and finished so that service was furnished to the Roachdale Electric Company on Feb. 8, 1922.

Except for about a mile of line, the entire route is along the highway. The longest tangent is one-half mile, there being many corners owing to the crookedness of the road. Right-of-way was secured from all property owners along the highway. The conductors are No. 6 hard-drawn bare copper, with No. 4 stranded bare copper for road crossings. The line wire joints were made with sleeves without solder. No ground wire is used as experience does not indicate a need for it in this locality. Poles are mostly AA Western red cedar, though a few B poles were used. Triangle steel arms were used and painted with two coats of red lead and oil.

The pin-type insulators on these arms are rated at a nominal line voltage of 45,000. Three 10-in. suspension units were used in each tension insulator assembly. Air-break switches with horn-gap lightning arresters

protect the incoming and outgoing 33,000-volt lines and the 37.5-kva., 33,000/2,300-volt single-phase transformer supplying the distribution system for the local consumers.

A 33,000-volt maximum demand and watt-hour outdoor installation is provided to meter the energy. The substation-supporting structure is made up of six wooden poles and 3-in. x 6-in. timbers, and the entire substation is surrounded by a wooden picket fence. The line and substation were designed by C. M. Poor, the general manager of the company, who also supervised the construction. Carrel Moore was the construction foreman.

C. W. OTIS,
Superintendent at Greencastle Station.
Wabash Valley Electric Company,
Greencastle, Ind.

CONSTRUCTION COSTS FOR 11 MILES OF 33,000-VOLT TRANSMISSION LINE

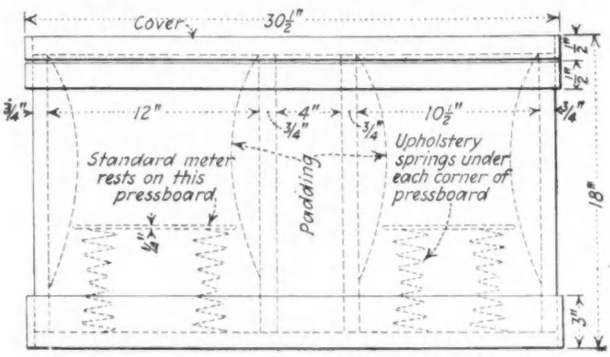
Pole prices given are f.o.b. shipping point. Hauling was done with a 1-ton truck and an army-type trailer. The figures given in the total-cost column are the book figures. Unit costs are calculated from these in a number of cases.

	Quantity	Unit	Unit Cost	Tota Costs
Right-of-way	11	Mile	$209.61	$2,305.73
Easements (poles, guys and tree trimming)	.....	.....	.....	830.50
Salaries	.....	.....	.....	210.00
Miscellaneous (recording fees, notary and expense of right of-way man)	.....	.....	.....	304.19
Clearing right-of-way	.....	.....	.....	880.95
Surveying	.....	.....	.....	80.09
Construction equipment	11	Mile	128.49	1,413.42
Operation of trucks	.....	.....	.....	572.51
Truck driver and helper	.....	.....	.....	840.91
Wooden poles, total:	458	Each	11.15	5,108.16
30 ft.	335	Each	7.15	2,395.25
35-ft.	25	Each	10.20	255.00
35-ft.	23	Each	11.25	258.75
40-ft.	18	Each	14.35	258.30
40-ft.	33	Each	16.70	551.10
45-ft.	10	Each	20.30	203.00
50-ft.	6	Each	23.20	139.20
55-ft.	4	Each	27.30	109.20
60-ft.	2	Each	32.65	65.30
65-ft.	2	Each	36.10	72.20
Digging holes	458	Each	1.38	640.69
Attaching cross-arms	458	Each	0.35	160.17
Conductors and insulators	32½	Mile	217.00	7,236.95
Copper wire:				
No. 6 hard-drawn, solid	13,424	Lb.	0.1525	2,047.16
No. 4 hard-drawn, strand	298	Lb.	0.1848	55.07
Insulators:				
10-in. disk	132	Each	2.55	336.60
10-in. disk	402	Each	2.33	936.66
Pin-type	1,194	Each	2.06	2,459.94
Labor	32½	Mile	.....	1,401.52
Cross-arms and hardware	11	Mile	227.17	2,498.82
Steel arms:				
36-in. triangle arms	378	Each	2.35	888.30
52-in. triangle arms	7	Each	4.00	28.00
Pins (truss)	1,183	Each	0.60	709.80
Strain insulators	225	Each	0.44	99.00
Angle-iron braces	12	Each	0.955	11.46
Anchors	90	Each	2.55½	229.74
Pike poles	4	Each	2.80	11.20
⅝-in D. G. steel strand	10.5	1,000 ft.	13.33	139.95
Paint and oil	.....	.....	.....	32.50
Bolts and dead-end clamps	.....	.....	.....	348.10
Freight and drayage	.....	.....	.....	353.83
Miscellaneous	.....	.....	.....	411.67
Total for entire transmission line	11	Mile	1,757.14	19,328.58
Transformer station for 33,000 volts	.....	.....	.....	3,816.24
37½-kva. transformers	1	.....	.....	577.80
Choke coils	3	Each	79.50	238.50
12-ft. insulated switch stick	1	Each	14.40	14.40
Air-brake switch, D. P. S. T.	1	.....	.....	259.00
Disconnecting switches	9	Each	48.92	440.32
Lightning arresters	6	Each	108.00	648.00
Metering installation	1	.....	.....	1,370.00
Freight and drayage	.....	.....	.....	58.81
Switching charges	.....	.....	.....	3.09
Miscellaneous	.....	.....	.....	59.69
Lumber	.....	.....	.....	41.22
Labor	.....	.....	.....	105.41
Line sectionalizing air-brake switch	.....	.....	.....	259.00
Total for entire installation	.....	.....	.....	$23,403.82

Transportation and Handling of Standard Meters

NO FACTOR in the testing of meters in service is more important than the proper care and maintenance of the standards used. The most careful calibration in the laboratory may be rendered useless by rough handling in the field or by jolting.

In order to eliminate the latter cause of trouble, the box shown herewith has been designed by the meter department of the Southern California Edison Company for the transportation of rotating standard meters. It is made to fit the express body of the Ford automobiles used on this class of work, and it contains four compartments for test meters of different sizes. Each compartment, the sides of which are padded with horsehair and canvas, has a removable false bottom, to the under side of which are fastened four small upholstery springs. This box is also very convenient for carrying other delicate instruments, clocks for graphic meters, etc.



PADDED BOXES ARE USED TO PROTECT STANDARD METERS DURING TRANSPORTATION

There are four cells with padding on all four sides of each. The two cells on the left measure 12 in. x 10 in. and the others 10½ in. x 10 in.

Test men are given strict instructions as to the care of standards, and they are particularly cautioned not to deface the cases in any way. At frequent intervals the test meters are brought in and revarnished. While a shabby or battered case may house a perfectly accurate standard, it is felt that the use of apparatus that looks new will have an important psychological effect in increasing the consumer's confidence in the result of the test.

H. R. THOMAS,
Meter Department.
Southern California Edison Company,
Los Angeles, Cal.

Specifications for Welding Wire Issued

THE results obtained from the use of various kinds of welding wire and chemical analyses thereof have been compiled during the past year and a half by the welding wire specification committee of the American Welding Society. Specifications based on this information have been drawn up and are now available.

This information has been found necessary because the notion prevailed several years ago that almost any fence wire was good enough for welding. Although good results are sometimes obtained from the use of such wire, it is now recognized that most careful attention must be given to the physical as well as the chemical characteristics of welding wire if good results are to be assured.

Management and Policy

Embracing Central Station Commercial Organization and Management, Customer and Trade Relationships, Public and Financial Policies, Advertising, Selling and Service Methods

An Electrical Home Designed and Built by Electrical Men

In Denver the Electrical Industry Combined to Finance and Construct a $22,000 House and Carried Out a Successful Home Electric Exhibition

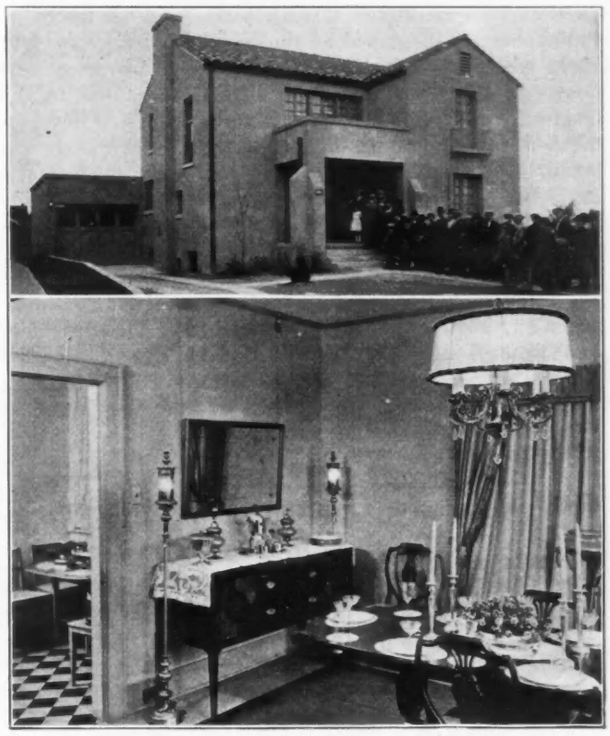
AT AN advertising cost of less than 10 cents per person, 36,992 residents of Colorado inspected the first electrical home in Denver, which was open for four weeks ended June 4 under the auspices of the Electrical Co-operative League of that city. In contrast with the electrical homes in other cities, the Denver home was designed, built and financed entirely by the electrical industry. A stock company, called the Electrical Home Building Company, was incorporated, with the leading electrical men of the city serving as directors. This company was not developed as a part of the league, but rather as an adjunct to it. More than $10,000 was raised by subscription, with shares priced at $10 apiece, and most of this amount came from individuals and not from companies.

Particular attention was given to planning the house with the view to making it as convenient as possible, but all freakish or unusual innovations were carefully omitted. The garage was attached to the house as shown in one of the accompanying cuts and was equipped with an electrical work bench and electrically operated door. The other views give a good idea of the interior and exterior appearance of the home. The cost of the house was close to $22,500, and the value of the interior furnishings was almost an equivalent amount. Daniels & Fisher, one of Denver's leading department stores, co-operated in furnishing the home, turning this work over to their interior decorator, who spared no effort to make the home modern and appropriate in every way.

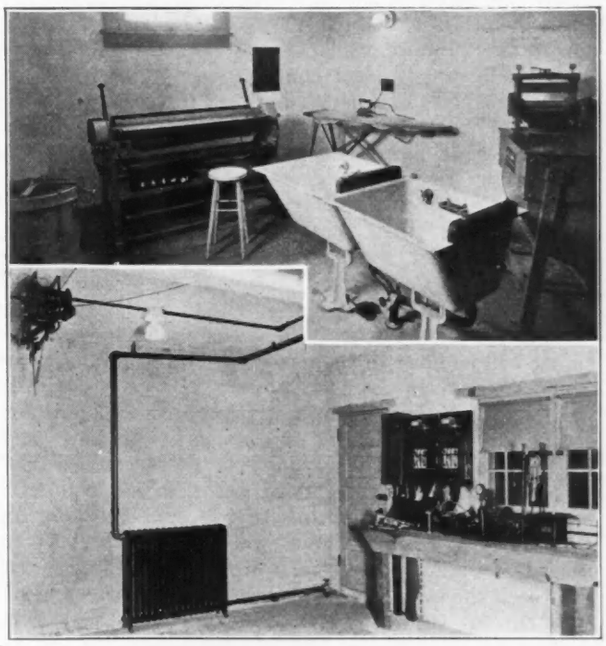
The wiring also provided three outlets for radio-telephone connections, one on each floor, with a special room in the basement for the receiving apparatus. The antenna was placed in the attic, and during the display nightly radio concerts were held.

In order that the display should be systematic, the committee in charge procured the services of twenty-eight attendants for two shifts. They were on duty from 2 p.m. until 10 p.m. daily, the first shift working until 6:30 p.m. and the other one coming on then and remaining until all visitors had passed through the house. To each of the principal rooms in the home was assigned an attendant who gave a three-minute talk to the visitors on the main features in that particular room. Several extra men were provided to relieve these attendants occasionally.

Invitations were furnished to the principal central-station companies in Colorado for attachment to their monthly statements, and the number of out-of-town visitors at the home showed the result of the co-operative publicity. Similar invitations were distributed by



FOUR VIEWS OF DENVER'S FIRST ELECTRICAL HOME, SHOWING EXTERIOR OF HOUSE, DINING ROOM, LAUNDRY AND ELECTRICALLY EQUIPPED GARAGE



the Mountain States Telephone & Telegraph Company to the number of 40,000. The Denver Gas & Electric Light Company prepared and distributed with all its statements an attractive four-color sticker inviting its customers to visit the home. The house-furnishing company issued engraved invitations to a special list of 3,000 names. Announcements also were carried on all cars of the street railway company and similar cards were placed in the windows of all electrical dealers.

Immediately after the home was opened interest developed in improved wiring plans and in many of the appliances displayed at the home. During the first three weeks more than a dozen sets of plans of new homes to be built in Denver were turned over to the league for perfecting the electrical lay-outs and development of a number of ideas featured in the electrical home. The electrical industry of Denver is enthusiastic over the successful exhibition, and the interest developed outside of Denver indicates a keen desire of the industry in this section to get into the movement.

The men responsible for the successful financing of the Denver project through the Electrical Home Building Company were Clare N. Stannard, vice-president and general manager of the Denver Gas & Electric Light Company, and L. M. Cargo and H. D. Randall, territory managers respectively of the Westinghouse and General Electric companies.

Comprehensive Commercial Policy Brings Results in Illinois

CONCRETE evidence of renewed and increasing commercial activity on the part of central-station companies is seen in the comprehensive plans of the Public Service Company of Northern Illinois and in the figures showing the amount of new business taken on during the first quarter of this year. Between Jan. 1 and the end of April this year the total number of contracts made with the company and with contractors for wiring old houses aggregated 526—largely exceeding the record of the same period in 1921 and falling short by roughly 150 of the total marked up in the first three months of the lively year 1920. Of these 526 contracts 123 were made by the company and the remainder by independent contractors.

The prospects of a large addition to the list of wired houses in 1922 are considered very definite. A comfortably large figure has been set as the goal to be attained by the company, and that number has been split into allotments to various districts. A thorough understanding with outside contractors has been reached. In fact, an electric league was organized last year by John G. Learned, assistant to vice-president, and is functioning in a fine spirit of co-operation. In driving for the addition of new customers large advertising will be done in the newspapers and in other ways found effective in the past.

In the first three months of this year 246 new contracts for the furnishing of electric power were made by the company. The capacity of these reached 5,763 hp., to which must be added the demand of electric ranges installed, amounting to 550 hp., bringing the total up to 6,313 hp. These figures are much above the record of January, February and March, 1921, but do not reach the total of that fraction of the big year 1920.

A careful survey of territory has been made with respect to the demand for electric power which will probably develop in 1922. After due consideration of all the facts assembled it has been decided to set a figure of 20,000 hp. as one represented in the additional contracts which it is believed can be secured.

The energy demand of electric ranges connected up in the three months here mentioned is over twice that of the new ranges put in service in the corresponding period of 1921. The Retail Merchandise Sales Department is sanguine that 1922 will be a notable electric range year.

Vancouver, B. C., Has 85 per Cent of Houses Wired for Electric Service

SOME interesting statistics have been compiled by the British Columbia Electric Railway Company showing the number of houses in Vancouver and surrounding districts and the proportionate number of homes wired for electricity. In the district served and accessible to the company's lines there is an average of 85 per cent of the homes wired for electric service. Ioco, a little oil town, holds the perfect percentage for the number of wired houses, having sixty-eight houses and sixty-eight customers. Vancouver comes next with an average of 95 per cent, 20,900 customers out of 22,000 houses. How the various districts shape up is shown in the accompanying table.

	Number of Houses On Lines	Number of Customers	Per Cent Wired
South Vancouver	9,000	7,650	85
Burnaby	3,500	2,980	85
Point Grey	4,400	3,960	90
City of Vancouver	22,000	20,900	95
North Vancouver	1,250	625	50
North Vancouver City	3,000	2,400	80
Fraser Valley	2,000	1,000	50
Chilliwack	900	720	80
Lulu Island	500	250	50
Steveston	800	640	80
Ladner (town)	300	240	80
Ladner (county)	250	125	50
Port Moody	250	190	75
White Rock	330	200	60
Coquitlam (including Port Moody)	1,000	500	50
Ioco	68	68	100
Hammond, Haney and Stave Falls	800	400	50
Totals and average	50,348	42,848	85

What Other Companies Are Doing

Paxton, Ill.—By co-operating with the city officials the Central Illinois Public Service Company has secured a new street lighting contract calling for the removal of the old arc lamps and the installation of a modern incandescent system. Ornamental lighting consisting of thirty-two posts in four blocks of the business district will also be put in. C. W. Amidon, division manager of the company, has been acting as electrical engineer for the city in this work and will supervise the installation, thus saving the city of Paxton a substantial amount of money.

Louisville, Ky.—One week's appliance sales by the Kentucky Utilities Company amounted to $4,107.05 and included thirty-five flatirons, eight electric fans, 18 hp. in motors, three electric ranges, a washing machine and a vacuum cleaner. Fifty-five house-wiring contracts were taken during the same period.

Milwaukee, Wis.—In two days' time 80 per cent of the 600 employees of the Wisconsin Gas & Electric Company purchased $200,000 of the company's issue of $500,000 of its new 7 per cent preferred stock. The Employees' Mutual Benefit Association of the company does not believe that this record has ever been equaled.

Manufacturing and Distributing

Devoted to the Discussion of Production, Distribution and Market Development, the Business and Economic Problems of the Manufacturer, Jobber, Agent, Contractor and Dealer

Interpreting the Corporation to the Workers

By C. M. Ripley
General Electric Company

PERHAPS no single thing has contributed more toward misunderstanding between employer and worker than the lack of information on the part of workers regarding the actual business done, profits, payroll and achievements of the particular industry in which they are employed. The experience of the General Electric Company in endeavoring to interpret its business to its employees may not be without benefit to other executives in the electrical industry and in all industries.

Let me illustrate. There was a strike on some years ago. There stood a picket who evidently was an Italian. In response to the question, "What's it all about, Tony?" the picket replied: "Ah, whatta-da-hell? We no getta our $4 a day unless Wall Street first getta their $24 a day." The way the remark was made showed a profound belief that the profits of industry were six times the payroll and that Wall Street owned the company.

Let us compare his contention with the facts. The payroll that year was approximately ten times the dividends, instead of the dividends being six times the payroll. Thus the error was a mere 6,000 per cent as the result of lack of information plus a generous amount of misinformation. And instead of "Wall Street" being the owner, 28,000 different stockholders, scattered all over the country, are the owners.

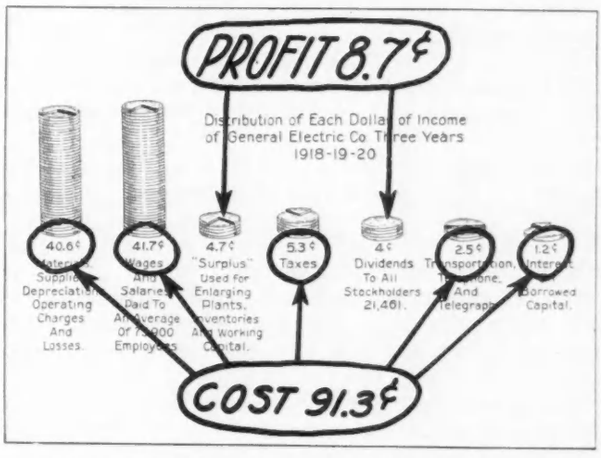
Not long ago an article appeared in the papers regarding the $40,000,000 cash of the General Electric Company. One office man was asked how long he thought that $40,000,000 would last in meeting the cash requirements of the company. He replied that it ought to last a year. Last year several office workers, including engineers and college graduates, were asked how much money the company spent every day in 1920. The answers varied from $10,000 a day to $200,000 a day. Imagine their amazement when they learned that the company's cash requirements that year were over $850,000 a day. Thus the $40,000,000 cash would meet the company's requirements for just forty-seven days.

In many conversations with presumably intelligent clerks, engineers, draftsmen and men in minor executive positions the subject was brought up of the size of the General Electric payroll in 1920. Estimates varied from "about $1,000,000" to as high as $100,000,000 — the latter estimate being made by a highly traveled man in editorial work. As a matter of fact, the payroll for that year was $128,000,000—thus showing a lack of fundamental information regarding the problems of industry.

Sherman Rogers says: "Actual industrial statistics for the rank-and-file employees are as scarce as radium. If a small per cent of the energy spent in suppressing radical literature, in imprisoning the agitators and in stopping their meetings had been spent in publishing actual industrial statistics and in answering the arguments of these individuals, there would have been but little need to worry about the constitution."

In an experimental way an educational lecture was prepared, at the suggestion of various General Electric executives, to show in pictorial form and in simple language the inner workings of the company. The lecture shows that the materials needed for building the company's product come from the four quarters of the world, and are gathered by the workers of white, black, yellow and brown races, who, although in foreign lands, are the unconscious partners of the inventors and engineers.

The sales organization of 6,000 employees is described, together with the fifty or more sales offices in the United States, and some of the problems of the sales department are discussed and illustrated. The corporate organization of the company is described and illustrated by a chart showing relation of stockholders, board of directors, executive committee, general officers, advisory committee, manufacturing committee, etc. It was explained that in 1920 there was an average of 83,000 employees engaged in more than a hundred offices and factories in fifty cities.



THIS PICTURE HAS BEEN EXTENSIVELY USED TO SHOW THE WORKER WHO GETS THE MONEY HE HELPS MAKE

The distribution of each dollar of the company's income was graphically illustrated, by piles of pennies. In addition to this, the total 1920 payroll of $128,000,000 was featured, from which the average employee is shown to receive $1,538. The average employee, shown as an imaginary composite creature with thirty arms, was illustrated in an artist's drawing. This showed the main functions of the entire organization as condensed into a single human being.

The sales billed in 1920 divided by the number of employees was equal to $3,320, and various photographs were shown of different kinds of apparatus and supplies

which the company sells for this sum of money. For instance, a transformer 13 ft. high and with a capacity of 1,250 kw. (over 1,600 hp.) was sold for $3,320, and lantern-slide illustrations pointed out that this transformer sold for 15¼ cents a pound (shipping weight) and contained 1.8 miles of wire, 6½ miles of cotton thread, 7.8 miles of paper tape and 5,300 different pieces of special silicon steel.

It was pointed out that this wonderful device was designed, the materials purchased, the machine built, sold, painted, boxed, shipped, billed, and the money collected, all in one year of 2,400 working hours. The reason why such a machine can be built by one imaginary composite average employee in one year was explained as being due to the division of labor, complete equipment, modern organization and electric drive of factory machinery.

A COMPOSITE OF A GENERAL ELECTRIC EMPLOYEE WITH A HAND FOR EACH JOB THAT HE DOES

As the result of the sale of $3,320 worth of apparatus and supplies in 1920 (neglecting sundry income), the stockholders received dividends of $129 in cash and two-thirds of one share of stock.

These facts give the employee an understanding of the relationship between sales billed, payroll, cash dividends and stock dividends. The numerous requests for this information from all sorts of organizations have almost convinced us that even the labor unions—yes, and the Socialists too—are earnestly, honestly and eagerly searching for the truth regarding industry, and that it will profit every manufacturer to present this kind of information to his own employees.

The Small Manufacturer's Pressing Distribution Problem

BY ONE OF THEM

SMALL manufacturers are unorganized and have no authorized and recognized spokesman. Yet because in many classes of electrical commodities they represent the majority of the business, they form an important element in this much-argued problem of distribution. Moreover, it is they who are often accused of muddying the waters by selling to the so-called imitation jobbers. Therefore it is well that the viewpoint of this small or "independent" manufacturer be put on record in the general discussion.

It is obvious that there are too many jobbers—too many concerns that call themselves jobbers—in many towns. It sets up an undue duplication of stock and organization, it forces a destructive competition that is largely maintained on a price basis. It embarrasses the true jobbers, reduces everybody's profit and demoralizes the trade. There can be no doubt of it. But there is a reason for it. And the reason is that there are so many manufacturers who cannot gain outlet and distribution through the large jobbing houses. A very large proportion of the latter are owned by or allied with the two large electrical manufacturers, who have built up chains of jobbing houses, operating in reality as glorified manufacturers' agents. They sell little or no competing material so the small manufacturer of a competing line is barred out and forced to sell through smaller distributors.

There are many independent jobbers throughout the land. True. But for a manufacturer seeking national distribution there are a surprising number of the most productive territories where aside from the "kept" jobbers there are too few to go around. The two big companies will have one each—or more—and there will be a few perhaps left over, but not enough. In some cities there will be no first-grade jobbers that are not "owned." In fact, more than half the members of the Electric Supply Jobbers' Association are "kept" jobbers, as well as a goodly proportion of those substantial jobbers who are not members. The result is that there is a relatively small number of large jobbing houses in the free field available to the small manufacturers.

SECURITY IN SMALL WHOLESALERS

One would naturally say, therefore, that the thing for the small manufacturer to do would be to tie up with as many of these free large jobbers as he can. But even this is a precarious policy. In one case that I know of a certain manufacturer has lost twenty-two large distributors in seven years because these houses were taken into one of the big jobbing systems, and since his was a competing line, he was compelled to look elsewhere for distribution. Therefore, because the policy of increasing the number of houses in these systems continues, it is of doubtful wisdom for a small manufacturer to establish himself with a large jobber in any city. After the territory is well developed and prospering with a good volume of demand, this conspicuously successful house may be gathered in by one of the big fellows and Mr. Small Manufacturer will walk the proverbial plank.

The large jobber who is doing well has become a shining mark. Therefore this particular small manufacturer and many others shun him and develop distribution through small wholesalers only. They would rather have ten little jobbers in a big city than one big one. It is safer, and a burnt child avoids the fire.

Undoubtedly such a policy leads to the setting up of many who are rightly called imitation jobbers, but if there is no recognized qualification to measure a jobber by, the manufacturer must decide for himself. He can only select houses that seem to be performing the economic functions of a jobber, but in the end the best qualification is the size of the orders that he places. If he sells the goods and pays his bills, he is a safe and probably a satisfactory distributor, because, being small, his overhead is so much lower than that of the big jobbers that he can compete with them, just as the small manufacturer cannot be exterminated by the big one because his costs also are lower.

The increasing number of small wholesalers in the electrical industry has undoubtedly complicated the processes of distribution. But there seems to be no way out of it so long as so great a number of the large jobbing houses are subsidized by big manufacturers, thereby barring out competing goods, which must and will have distribution.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Magnetic Flux Distribution in Transformers.—KARL B. MCEACHRON.—Using a simple test core-type transformer, provided with belt exploring coils under both the primary and secondary windings, data concerning the magnitude and phase positions of the fluxes in different sections of the core were secured. The results show that leakage fluxes do not exist as separate fluxes in the core.—*Journal of the A. I. E. E.*, April, 1922.

Methods for Laying Out Coils.—A. C. ROE.—Procedure for laying out new coils when old coils are not available is prescribed for direct-current armatures and alternating-current stators.—*Electrical Review and Industrial Engineer*, April, 1922.

Cascade Group of Asynchronous Motor and Commutator Motor.—R. LANGLOIS.—The author gives an elaborate theoretical analysis of the function of a cascade group consisting of an asynchronous motor and a commutator motor. Such a group is being used in several rolling-mill drives with three-phase current and also for the improvement of the power factor of asynchronous motors.—*Revue Générale de l'Electricité*, April 15, 1922.

Lamps and Lighting

Electric Farm-Lighting Plants.—The author presents a number of interesting arguments for and against automatic, semi-automatic and manually operated isolated farm-lighting outfits. He claims that all factors are in favor of the low-speed kerosene-motor plant with a large storage battery on account of the not quite reliable operation of the fully automatic or even the semi-automatic gasoline sets. A manually operated station requires very little attention and will last for ten years or more, while automatic stations will be good for only two or three years, the author asserts. A tabulation of twenty-five different plants is given, comprising all three systems, with their main data, including cost.—*L'Industrie Electrique*, May 10, 1922.

Generation, Transmission and Distribution

Winnipeg City's Hydro-Electric System.—E. V. CATON.—The power house of this system is situated at Point du Bois on the Winnipeg River, 78 miles northeast of Winnipeg, Manitoba. A detailed summary of the generating and distributing equipment and of the plant is given. Eleven units are now installed with a total capacity of 49,500 kva. Energy is generated at 6,600 volts, three-phase, 60-cycle, and is transmitted on four lines built on two sets of steel towers at 56,000 volts.—*Electrical News*, April 15, 1922.

Expectation of Efficiency of Steam-Boiler Operation.—H. R. CARR.—Empirical curves are developed enabling the expected efficiency of a boiler installation to be determined with a fair degree of accuracy. The method of using these curves and the conclusions that can be drawn are explained.—*Power Plant Engineering*, April 1, 1922.

Grounds on a Transmission Line and the Principle of Superposition.—H. HO.—The convenience of applying the principle of superposition of currents and electromotive forces in investigating the phenomena resulting from an accidental ground and its opening on a transmission line is pointed out.—*Journal of Institute of Electrical Engineers of Japan*, March, 1922.

Large Water-Turbine Installations.—W. HAHN.—A general description, with numerous photographs and drawings, of the turbines and power stations given in the accompanying table.—*Elektrotechnik und Maschinenbau*, March 19 and 26, 1922.

Location	Year	Head, Meters	Size, Hp.	Turbines, Installed	Type of Turbine
Niagara Falls	1913	54	16,000	12	Twin-spiral
Lienfos, Sweden	1912	17	5,100	3	Twin-drum
Svaelfos, Sweden	1913	47	12,000	..	Twin-drum
Tokio, Japan	....	104	11,400	6	Twin-spiral
Rjukanfos, Norway	1915	276	16,000	10	Twin-Pelton
Glomfjord, Norway	....	442	27,500	3	Twin-Pelton
Ottawa & Hull Power & Manufacturing Company	....	11.6	10,000	..	Double-twin
Whylen, Germany	1913	7.5	3,000	10	Double-twin
Meitingen, Germany	....	15	7,000	3	Twin-drum
Raanaasfos, Norway	1921	13	14,000	..	Twin-drum
Leitzach, Germany	1914	115	4,400	5	Single-spiral
Walchensee, Germany	1921	200	18,000	4	Twin-Pelton
Walchensee, Germany	1921	200	24,000	4	Twin-spiral
Sorocoba, Brazil	1914	.....	17,500	3	Twin-spiral
Meran, Austria	1914	300	8,000	..	Twin-Pelton
Ruetz works, Austria	1913	170	4,000	2	Pelton
Ruetz works, Austria	1921	170	8,000	1	Pelton

Installations, Systems and Appliances

Three-Phase Arc Furnace for Copper and Brass.—E. RUSS.—An arc furnace is described which can be connected directly to any three-phase line. Rocking the furnace during its operation gives a very uniform distribution of the heat and prevents excessive burning of the melted metal. An average power factor of 0.90 per cent is maintained. The lining will hold for 500 to 800 charges. The consumption of the furnace varies between 250 kw.-hr. and 400 kw.-hr. per metric ton of metal. Standard sizes of 500 kg. to 2,000 kg. are manufactured. — *Elektrotechnische Zeitschrift*, April 13, 1922.

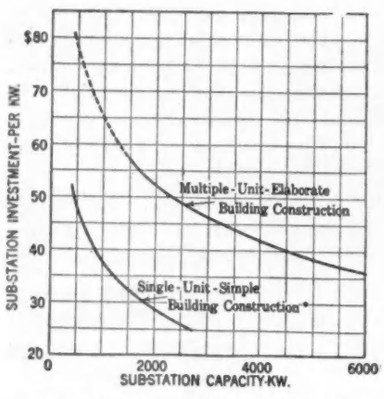
Central Control of Motors.—ORVILLE F. LONG.—From a single dispatching board 135 motors ranging in size from 1 hp. to 225 hp. are started and controlled. Any circuit may be easily tested when troubles develop. The layout of the system and the use of special connectors make it easy to replace equipment in this plant of the Kelsey Wheel Company, Inc., Memphis, Tenn. On the small motors circuit breakers and relays are used. For large motors oil switches are used.—*Electrical Review and Industrial Engineer*, April, 1922.

Synthetic Cast Iron.—J. L. CAWTHON, JR.—The author discusses in detail manipulation of the heat in the production of synthetic cast iron in the electric furnace with respect to its five principal alloys—carbon, silicon, manganese, sulphur and phosphorus.—*Paper presented before the American Electrochemical Society, Baltimore*, April 27, 1922.

Traction

Operation of an Electrified Terminal.—L. E. LYNDE.—Comparison of the conditions at the Broad Street (Philadelphia) station of the Pennsylvania System before and after electrification.—*Electric Traction*, May, 1922.

Economics of Direct-Current Railway Distribution.—L. P. CRECELIUS and V. B. PHILLIPS.—The purpose of this paper is to determine, first, the relations that govern the size of feeders and the correct feeder layouts for any given arrangement of substations and, second, the principles underlying the correct location, size and type of substations, assuming the fullest development of automatic and semi-automatic control. The limit of substation investment, without land, is shown in the accompanying illustration. The upper curve is based largely upon Cleveland substation costs, while the lower curve, on the other hand, is based on the smallest and simplest buildings possible.—*Journal of the A. I. E. E.*, May, 1922.



AUTOMATIC SUBSTATION COSTS FOR 60-CYCLE CONVERTERS

Electrophysics and Magnetism

The Disappearance of Gas in the Electric Discharge.—N. R. CAMPBELL and H. WARD.—The experiments described were concerned primarily with the disappearance of gas in the presence of phosphorous vapor. In the main they were directed to the determination of how the quantity of gas absorbed in the discharge in the presence of phosphorus varies. The experiments take up the nature of the gas and discharge, the form of the vessel, the pressure of the gas, the relation between the amount of gas absorbed and the amount of phosphorus present and the effect on the walls of the tube.—*Philosophical Magazine (London)*, May, 1922.

The Inner Structure of the Pearlite Grain.—COL. N. T. BELAIEW.—Investigations made by the author on the crystallization of steel, using a series of alloys specially prepared under conditions of extremely slow cooling.—*Engineering*, May 19, 1922.

Electrochemistry and Batteries

The Corrosion of Lead-Covered Wiring by Oak.—P. DUNSHEATH.—An unusual case of corrosion of lead where a lead-covered cable ran through timbers of oak is described, with a partial analysis of the causes.—*Electrical Review*, May 19, 1922.

Conductivity of Copper-Refining Electrolytes.—E. F. KERN and M. Y. CHANG.—The specific conductivities of solutions of sulphuric acid and copper sulphate and of mixtures of sulphuric acid and copper sulphate were determined at 25 deg. C., 40 deg. C. and 55 deg. C. Tables and curves are given for the several solutions of varying concentrations and for different temperatures. The effects of the impurities were also investigated, the most important discovery being that the presence of nickel sulphate and ferrous sulphate depresses the conductivity very much.—*Paper presented before the American Electrochemical Society, Baltimore*, April 27, 1922.

Units, Measurements and Instruments

Direct-Reading Henry (Inductance) Meter.—R. BARTHÉLEMY.—The author has devised and described in this paper an instrument consisting of a magneto which generates an alternating current that is made to pass through a fixed self-inductance in series with the unknown exterior inductance. In parallel with the external inductance is a direct-current voltmeter, which receives current from the magneto over a mechanical rectifying commutator on the shaft of the magneto. Depressing a push-button disconnects the magneto from the unknown inductance and makes connection with a comparison inductance. From the resulting two readings of the voltmeter the unknown inductance may be determined. Several examples for the use of this new instrument are explained.—*Revue Générale de l'Electricité*, March 25, 1922.

Telegraphy, Telephony and Signals

Practical Application of the Telephone Repeater.—H. S. OSBORNE.—Attention is called to some of the fundamental conditions of telephony which make the telephone repeater of such importance. Several examples are given of the use of this repeater in special telephone service.—*Journal of Western Society of Engineers*, May, 1922.

Radio Transmission Over Long Distances.—G. MALGORN.—The formulas of different investigators as to the amount of energy transmitted between sending and receiving stations in relation to the height of the antenna, wave length and antenna resistance give very different results. The author compares such formulas, as, for example, those of Austin, Sommerfeld, Howe, Cohen and others, and shows their relative differences. A special expedition on board the ship *Aldebaran* was recently authorized the aim of which was to measure the signals emitted by Nantes, Lyon and other high-power stations. The results have been tabulated, and from these values an alignment chart was constructed, which gives direct readings of such dimensions as height of antenna, wave length, distance between stations.—*Revue Générale de l'Electricité*, April 8, 1922.

Miscellaneous

Water-Power Resources of Canada.—J. T. JOHNSTON.—A general review of the water-power developments, tabulating the available power with that developed. In the accompanying table the power utilized in central stations and in the pulp and paper industries is given for each province. The water power now developed represents an investment of $530,000,000.—*Canadian Engineer*, March 28, 1922.

DEVELOPED WATER POWER IN CANADA

Province	—Turbine Installation in Horsepower— In Central Stations	In Pulp and Paper Mills	In Other Industries	Total
British Columbia	207,656	48,800	48,859	305,315
Alberta	32,380	.....	807	33,187
Saskatchewan	.....	.....	.....	.....
Manitoba	93,355	.....	10,792	104,147
Ontario	948,372	170,624	93,654	1,212,650
Quebec	696,593	224,412	94,380	1,015,385
New Brunswick	8,978	14,668	6,534	30,180
Nova Scotia	14,992	17,999	13,957	46,948
Prince Edward Island	245	.....	1,624	1,869
Yukon	10,000	.....	3,199	13,199
Total for Canada	2,012,571	476,503	273,806	2,762,880

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Marconi Shows Results with Short Waves in Radio Experiments

POINT-TO-POINT radio sending with a one-meter wave was demonstrated by Guglielmo Marconi before a joint meeting of the Institute of Radio Engineers and the American Institute of Electrical Engineers in New York on June 20.

Mr. Marconi said that his present investigations were with short waves and that this new and promising field of radio offered superior possibilities of development. At the same time he reviewed the long-wave radio development and showed how it had progressed by leaps and bounds.

In England they now use sixty bulbs and 100 kw. in the antenna, with a radiating efficiency of about 50 per cent, on 20,000-m. waves. Aside from the protection from interference given by directional reception, a close filtering and an element of saturation, no particular methods have been developed for eliminating static, Mr. Marconi said. However, the effective speed has increased eight to ten times since 1912 owing to many small improvements.

A new air-core type of transformer as invented by G. Mathieu was described by Mr. Marconi. This transformer increases the amplification factor of a tube from 5 to 15 per cent and is a noteworthy development in the art of amplification.

Investigations on a world-wide basis are now being carried on to determine the strength of signals that can be relied on over given distances and to find the ratio of the strength of signals to that of static and other interferences acting on receiving stations. These investigations seem to bear out the prediction of Mr. Marconi that at the Antipodes radio waves reunite and become in phase so that signals can be received with ease. The signals do not follow the great circles, but follow well-defined paths independent of distance to a large degree.

Conclusions Concerning Static

On his trip across from Europe, Mr. Marconi found that static came from Europe until the halfway point was reached and then seemed to originate in America. All static seems to be greatest and to originate over land areas and to behave very irregularly in the different parts of the earth. Transmission from west to east is far easier than from east to west in all parts of the world.

The new lines of investigation pursued by Mr. Marconi are in the use of continuous short-wave lengths. In the words of Dr. Pupin, he has "returned to his first love." Every experiment with the short waves shows that wonderful possibilities are opened up. No static interference occurs, very sharp directional sending and receiving may be accomplished, and one antenna may be used to send and receive at the same time. By means of tubes it is possible to produce 12-m. waves which utilize a power of several kilowatts.

Using a revolving reflector for these short waves and signals for each half point on the compass, ships off Scotland have been able to locate the sending station within one-quarter point of the compass, or 2.8 deg.

A duplexing radio-telephone system of 20 miles is in operation in England between London and Birmingham which uses the short waves and reflectors with astonishing results. Communication is kept up at all times without distortion. The same type of system has also been used between England and Ireland. The attenuation of these short waves is so very regular over the sea that distances can be accurately measured by the strength of the signals.

The Institute of Radio Engineers conferred its medal of honor on Mr. Marconi, the presentation being made by A. I. Cutting.

Dr. M. I. Pupin of Columbia University and E. H. Armstrong of the General Electric Company paid tribute to Mr. Marconi in enthusiastic terms.

New Minority Report on Muscle Shoals Assails Ford Offer

EIGHT members of the House military affairs committee opposed to the Muscle Shoals project of Henry Ford have united in a new minority report prepared by Representative Kearns of Ohio. These members include Messrs. Parker of New Jersey and Frothingham of Massachusetts, who had previously made a report in opposition to the Ford bills. In this new report Mr. Ford's proposal is attacked without gloves.

The properties for which Mr. Ford offers the government $5,000,000, the report says, already have cost the government $85,487,900. It declares the amount offered "seems wholly inadequate when it is remembered that Mr. Ford could immediately dispose of the Gorgas plant to the Alabama Power Company for $2,500,000." Additional appropriations totaling $50,000,000 would have to be made if the Ford offer were accepted, the report says, with the result that the government would suffer a further loss of $13,350,000 in interest, "returning to Mr. Ford in this one item of interest his $5,000,000 and $8,350,000 besides."

Under the head of "frenzied finance," the report goes on to say that Mr. Ford would repay the government in a hundred years only $4,674,000 of the $50,000,000 to be expended by it on the dams "Men everywhere who understand this proposition condemn it in unmistakable terms," the report continues. "The entire people will some time know what fraud is being attempted, and then the condemnation will be universal."

The report favors concurring in the Senate appropriation of $7,500,000 to continue work on the Wilson Dam,

the leasing of the government nitrate plants, the abandonment of the proposed Dam No. 3, and the authorization of the Secretary of War to entertain new Muscle Shoals proposals.

A dispatch from the ELECTRICAL WORLD'S Washington correspondent received as it goes to press says that no rule to permit consideration of the Mackenzie, or majority, Muscle Shoals bill will be brought into the House prior to the recess and that the House will probably vote to concur in the Senate appropriation. The Kearns report, he says, has intensified the opposition to the Ford proposals. Representatives of consumers who get their power from the Alabama Power Company have been in Washington urging that that company be allowed to retain the Gorgas plant.

Muscle Shoals became the subject of a running debate in the Senate last Saturday when Senator McKinley of Illinois read a letter from James E. Smith of St. Louis, the president of the Mississippi Valley Association, in which the acceptance of Mr. Ford's offer with the Gorgas steam plant included was urged. Senator McNary of Washington said the proposed contract would "fall under the control of Wall Street within three days after Mr. Ford's funeral." Senator Underwood said that the Ford proposal should be either accepted or rejected before Congress adjourns. Senator Norris replied that the legislative situation was such that no reasonable hope could be entertained for the disposal of the matter at this session. Senator Underwood expressed the opinion that there would be time to take it up while the tariff bill is being considered by the conferees of the two houses.

Senator Heflin of Alabama warmly advocated the Ford proposal, quoting one of Mr. Ford's representatives as saying that most of the power developed at Muscle Shoals will be used in the making of fertilizer. Senator Norris expressed the opinion that the bulk of the power would be used for manufacturing purposes. He attacked the Ford offer vigorously, saying that it was a proposal to sell a birthright for a mess of porridge.

Senator Norris concluded by introducing a resolution proposing that the Federal Trade Commission report to the Senate whether or not the production or sale of fertilizers is controlled by any monopoly or whether any conspiracy exists under which the price of fertilizers is enhanced.

New Officers Chosen for the Canadian Electrical Association

AT THE executive session of the Canadian Electrical Association held in connection with its convention at Ottawa, Ont., last Saturday the following officers were elected: President, P. T. Davies, Southern Canada Power Company, Montreal; vice-presidents, R. J. Beaumont, Shawinigan Water & Power Company, Montreal; A. P. Doddridge, Quebec Railway, Light, Heat & Power Company, and L. W. Pratt, Hamilton (Ont.) Cataract Light & Traction Company. Eugene Vinet resigned as secretary-treasurer, having accepted a position with a large electric public utility organization in Chicago, and J. Coffey of the Southern Canada Power Company was appointed secretary-treasurer pro tem. Regret was expressed over Mr. Vinet's resignation and his loss to the Canadian association, for which he has done such excellent work during the last three years.

President Smith Impressed with Association Work in the West

FRANK W. SMITH, president of the National Electric Light Association, has just returned from a tour of the Pacific Coast and is most enthusiastic over the outlook. When seen by a representative of the ELECTRICAL WORLD soon after his return, Mr. Smith said:

"In an endeavor to become thoroughly conversant with electrical conditions throughout the country, I made a trip to the Pacific Coast, attending the convention of the Pacific Coast Electrical Association at Los Angeles and that of the Northwest Electric Light and Power Association at Boise, Idaho. The thing which impressed me at both conventions was the solidarity of the electric light and power business and the great enthusiasm which managers and operators alike show in the business.

"In California, of course, chief interest centers in the water and power act to be voted on this fall, and I was greatly heartened by the confidence shown by the leaders of the industry on the Pacific Coast in the ultimate defeat of the proposed measure. To an outsider viewing the enormous development that has taken place in California and realizing to what extent this development is due to electricity and to the privately owned electric public utilities providing it, it is unthinkable that so revolutionary and socialistic a change as that proposed in California can be brought about.

"Naturally the companies on the Pacific Coast are warm in their praise of the work done by the national association, particularly in the preparation of the Murray and Flood report on the Hydro-Electric Power Commission of Ontario and in the work of the water-power committee in its dealings with the Federal Power Commission at Washington.

"I was informed that the attendance at the convention held in Los Angeles was unprecedented and that executives who were never before known to attend a convention were present. This to my mind is indicative of the great interest which has lately been shown in association affairs, and, needless to say, it will be the aim of the staff at headquarters to maintain and even deepen this interest.

"California is certainly showing a wonderful growth. Depression, as we know it in the East, apparently does not affect it. Her crops are constantly increasing in size and in value, and it is significant of the excellent work done by the public utilities of the state that almost every business interest and public-spirited citizen recognize to what extent this growth and expansion has been made possible through electrical development.

"At the convention at Boise the same keen interest in association affairs was manifest. As in Los Angeles, one whole session was given over to an industrial conference. That at Boise was held in a theater and was open to the public. I am confident that meetings of this kind cannot help but be of great benefit to the public as well as to the utilities.

"We are engaged in one of the most progressive of industries, one that has attracted engineering and executive talent of a high order and one which has contributed in some instances more than the railroads themselves to the upbuilding of the country. For example, I was amazed in looking out of the train window to see so many small communities with no paved streets,

no water or fire protection system, and apparently no sewers, and yet possessing electric service. The roads were well lighted and apparently the homes also. Of course, with vast interconnected networks it becomes possible for such communities to obtain almost as good electric service as large cities do, and at reasonable cost.

"An Easterner is always impressed with the great distances of the Far West, and an electric light and power man is also struck with the daring and magnitude of the electrical undertakings, the faith in the industry felt by the men engaged in it, and the great investment necessary to reach sparsely settled communities. Certainly, electricity is used more per capita on the Pacific Coast than elsewhere, and considering the great outlays made for generating and distributing it, the cost is remarkably small. Just to see the industry at work in the West is an inspiration, and the enthusiasm they show in it is certainly catching. The work done in customer ownership of securities is nothing short of marvelous.

"It is my purpose to bring the N. E. L. A. into more intimate contact with the various sections of the country and thus weld the organization as a whole into a more compact and efficient body. The chairmen of the various committees have all been appointed so that work for the next administrative year may begin at once, and the first meeting of the executive committee will be called at New York on July 20.

"In addition to addressing the conventions of the Pacific Coast Electrical Association and the Northwest Electric Light and Power Association, I transmitted a speech to the Canadian Electrical Association and spoke to the New York Bankers' Association, in convention at Lake Placid, by radio from Schenectady. Naturally, my heart and soul are in this work, and if the enthusiasm that they have on the Pacific Coast can be spread over other sections of the country, the industry will enjoy not only well-deserved popularity but great expansion as well."

Iowa Men Discuss Inductive Interference and Rural Lines

INDUSTRIAL interference, rural lines, group insurance, sales of securities to customers and electric cooking were prominent among the topics that came before the Iowa Section of the National Electric Light Association when it met at Lake Okoboji, Iowa, on Tuesday to Friday of this week. The president, S. C. Dows, also dwelt in his opening address on the desirability of a uniform accounting system for municipal utilities and on the steps being taken to revise the rules governing overhead wire crossings in the interests of safety.

Pleasure at the way in which the telephone and power interests have got together in work on the inductive-interference problem was expressed by Dwight N. Lewis, chairman of the Iowa Board of Railroad Commissioners, in his address on Tuesday. Both telephone and light and power lines must occupy the highways, he said, and the commission intended to see that cheap and flimsy construction is prohibited on rural lines, for which the commission has recently issued specifications.

Mr. Lewis criticised a few men who have made it a practice to construct cheap lines and then unload them on the farmer, promising trouble for these individuals and protection to the men who are promoting adequate construction.

A fuller report of the convention proceedings will be printed in the ELECTRICAL WORLD next week.

Study of Cost Factors in Rates Urged at St. Paul Convention

A PLEA for consistent analysis of the costs of operation to aid in determining whether business being handled is profitable and whether additional business that can be taken on is likely to prove profitable was made by W. S. Heald of Duluth before the North Central Electric Association at its second day's sessions at St. Paul last Thursday. He showed how it is possible for any one familar with the conditions on any given property to separate the costs into the principal factors, such as customer expense, capacity, street lighting and like factors, in a way that will give a practical basis for checking the accuracy of rates.

Martin J. Insull said that one of the principal faults of utility men in handling relations with the public is the failure to understand that the things which seem simple and obvious from the utility viewpoint are not so to the public. Many misunderstandings arise from this failure. He also said that it was not generally appreciated that while in some phases of their business the central stations are necessarily monopolies, they are in active competition with other forms of energy supply for favorable public opinion and in the money markets, where the competition is far keener than it is anywhere else. Because the public has invested in wiring, appliances and other means of utilizing electric service about two dollars for every dollar of utility investment, he said that public interest in the maintenance of successful utilities is greater than the interest of the utilities themselves.

That newspapers cannot be bought by the use of advertising space and that their advertising space has a real value that can be utilized by the preparation of proper copy and intelligently directed advertising campaigns was the message George F. Oxley, director of publicity of the National Electric Light Association, brought the convention in discussing "National Good-Will Advertising."

Inductive interference was discussed by R. F. Pack, who presented the report of the joint general committee representing the N. E. L. A. and the Bell Telephone System. S. B. Hood of Minneapolis reported for the geographic division committee on this subject. A careful study of the report was urged, as was the need of backing the work of the committee through effective local co-operation with the telephone systems. A representative of the Bell companies said that telephone engineers who have the duty of carrying out their part of the co-operative work were stationed at the companies, division offices in Omaha, Des Moines, Minneapolis and Fargo.

The officers elected for the ensuing year are: President, W. S. Heald, Duluth; vice-president, R. M. Howard, Winona, Minn.; treasurer, A. L. Kippels, St. Paul. The executive committee will be composed of H. L. Thomas, St. Paul; J. W. Peterson, Fergus Falls, Minn.; W. C. Blanchard, Aberdeen, S. D., and W. L. Hibbard, Fargo, N. D. Interest in the association was shown by the fact that the registration this year was 380, as compared with 237 last year.

Reserve Stocks of Coal Shrinking Toward "Danger Mark"

WITH reserve stocks of bituminous coal depleted to approximately 26,000,000 tons, or within less than one week's consumption of the "danger mark," which has been officially placed at between 20,000,000 and 25,000,000 tons, reports reaching the Geological Survey this week indicated a reduction in the output for the eleventh week of the strike. Production of soft coal in the tenth week was 5,078,000 tons, while the returns forecast less than 5,000,000 tons for the week that followed this.

After a conference between retailers and operators Secretary Hoover announced that it had been settled with the representatives of the retail association that they will co-operate to insure that all coal be sold at cost plus a reasonable selling charge and that in localities where bituminous coal is sold for household purposes existing stocks, as of June 1, of unsold pre-strike and contract coal be reserved for the smaller household trade and such coal be sold at prices based upon cost plus usual handling charges. Except for the above coal, the retail prices are to be based upon average purchase prices with usual handling charges. Retailers are to co-operate to prevent rising mine prices by calling the attention of the administration to price demands out of line with the established bases and they are to handle coal on straight lines from operator and wholesaler without speculative resales in the trade.

Following the meeting emphasis was placed on the fact that larger consumers should buy coal at this time when unsold surpluses exist at Virginia tidewater points and in Alabama. If that type of consumer would make his purchases now, it would make for a better situation later in the season when the demand from small consumers will enlarge.

In a further statement Secretary Hoover said: "In the field where a price basis has not yet been established (only 15 to 20 per cent of the total tonnage now being produced), I earnestly request that each operator immediately reduce his selling basis for spot coal to the Garfield price, including the standard selling expense, plus such additions for increased costs as can be justified in his individual case. Owing to the persistent misstatement or misunderstanding of elements inside and outside of the industry, the impression has been given in some quarters that the maximums constitute minimum prices and offer reason for some occasional taking of advantage of such price basis. It is in the interests of the good repute of the industry, as well as that of the public, that the formula for computing prices in relation to the Garfield scale should be conscientiously applied by all operators."

There have been few violations of the spirit of this arrangement in Virginia, West Virginia, eastern Kentucky and Tennessee, where prices for spot coal vary from $2.50 to $3.25, with an occasional price at the maximum, but with an average of about $3. At the same time more than half the tonnage is moving as contract coal at averages below $2.25. Alabama coal is being offered at from $1.82 to $2.10. The refusal of the operators in western Kentucky to accept the maximum which Secretary Hoover prescribed is generally held to be a very short-sighted policy.

Pressure already is being brought on the administration to arrange for the arbitration of the strike. Most of this pressure has its origin in the Northwest. That seems to be the only section of the country in which any nervousness is developing. New England is getting all the bituminous coal it is willing to buy.

S. P. E. E. Champions Engineering Leadership in Production

PROF. CHARLES F. SCOTT of Yale University in a stirring address as president of the Society for the Promotion of Engineering Education, at its annual convention this week at the University of Illinois, pictured the position of the engineer as something more than a master of engineering details of design and construction. The engineer must show leadership in production and in the elimination of waste of human effort in manufacturing processes and in the management of these processes. If he is to show this leadership, Professor Scott said, the engineering universities must know how to provide instruction that will make it possible to know more about the fitness of the students they graduate and how effective that instruction is during the period it is being given. The building up of efficient teaching staffs, he declared, must be one of the prime functions of the Society for the Promotion of Engineering Education, if that organization and the educators who compose its membership are to lead and not follow the requirements of industry and to develop men who are prepared to deal with the new and changing problems in engineering that involve economic and management phases. In line with this expression of opinion, the council of the society adopted the following resolutions:

Whereas the president of this society, visioning the future, has, after a careful study of the possibilities of greatly enlarging the scope of its activities, made certain recommendations, and whereas in his opinion there is a reasonable possibility of securing funds for the society for the promotion of engineering education if an adequate plan is developed and indorsed by this society, and whereas in the opinion of the council this society stands challenged by the conditions thus presented, now be it resolved that the president of this society appoint a committee of five members, including himself, to study the development of the Society for the Promotion of Engineering Education and to formulate an answer to the question "what can the society do in a comprehensive way to develop, broaden and enrich engineering education?" and further, that this committee shall report as early as feasible its formulation of an answer back to the council for action on the committee's recommendations.

The keynote of all the discussions at the sessions of the society was the development of teachers who can train engineers, with an analysis of the plans that are now being studied to make university training more effective. The plan of instruction for freshmen now being followed at Purdue University, as inaugurated and explained by Dean A. A. Potter, created much discussion. This plan aims to stimulate the interest of the student early in his course by introducing engineering problems that appeal to his instincts and deal with actual situations calling for solutions designed to train the student to "think clearly, act quickly, equalize carefully and calculate accurately." It is also a rough measure of his fitness to pursue engineering work. The instruction includes general lectures, inspection trips and simple engineering problems. The discussion showed that similar work is being conducted in several other colleges.

Important Interconnection Expected in Massachusetts

FALL RIVER and New Bedford, Mass., will be interconnected electrically in the near future, if plans now being completed mature as expected. The New Bedford Gas & Edison Light Company is enlarging its Cannon Street station to a total generating capacity of 92,000 kw. in anticipation of the purchase of energy by the Fall River Electric Light Company. The turbine room and switchboard galleries are being extended 40 ft. and the boiler house 80 ft., the latter to afford a total boiler capacity of 72,000 kw. Four new 1,608-hp. boilers, a 55,000-cu.ft. air washer, two concrete stacks, coal-handling machinery and other auxiliary apparatus are being installed. Engineering details of the proposed tie line are not yet finally determined, but when this is completed all the leading central-station and transmission systems from southeastern Cape Cod to the northwestern Berkshires will be electrically connected, roughly including nearly 750,000 kw. in steam and hydro-electric generating capacity. Some of the ties are not of the trunk-line type, but already 66,000-volt trunks run from Fall River to the upper Connecticut and Deerfield valleys and contribute to the efficient handling of interconnected plants.

Candidate for Governor of New Jersey Proclaims Utility Plank

A DECLARATION has been made by State Senator Runyon, Republican candidate for Governor of New Jersey, that, in accordance with his interpretation of the meaning of the United States Supreme Court's decision in the recent Galveston Electric Company case, he favors strict adherence to "actual values" of public utilities as a basis for rate making.

"I believe," said Mr. Runyon, "that the values on which rates are based should be actual values, excluding good will, franchise value, past deficits, development cost, hypothetical brokerage fees, deferred maintenance, federal taxes and other similar items. The public utilities act should state explicitly what items the commissioners shall take into consideration and what items they cannot take into consideration in valuing the property of the public service companies."

Rate Dispute at Springfield, Ohio, Is Not Settled, After All

ALTHOUGH an agreement had been reached between members of the Springfield (Ohio) City Commission and the Springfield Light, Heat & Power Company for a domestic light scale of 9, 6 and 3 cents and the agreement had been ratified by the company directors, as related in the ELECTRICAL WORLD for May 27, page 1085, the City Commission rejected the schedule when the matter formally came before it in ordinance form, and as the result the future rate for Springfield remains in doubt. The City Commission not only threw out the proposed new rate but also repealed the ordinance now in effect, which provides a rate of 11 cents for the first 15 kw. and 7 cents for all additional energy. An ordinance providing for a rate for one year of 8 cents for the first 15 kw.-hr., 6 cents for the next 45 kw.-hr. and 3 cents for all additional energy seems certain of adoption by the City Commission, but its definite rejection has been announced by C. I. Weaver, general manager and vice-president of the company, who said, however, that the company would take no action toward appealing the case to the Public Utilities Commission until the ordinance had actually been adopted by the City Commission, which is expected to consume about six weeks. The proposed rate, Mr. Weaver said, is far below the cost of service.

If the Public Utilities Commission follows its usual custom when the case reaches it and orders the present rate to be charged pending the fixing of a proper rate, the city, it is thought, will attack the jurisdiction of the commission in the courts, pointing out that Springfield operates under the charter form of government.

Carrier-Current Relay Control Opens Door to System Simplification

SIGNIFICANT tests of carrier-current relay control by radio engineers of the General Electric Company at Lynn, Mass., were referred to in the ELECTRICAL WORLD of June 17, page 1238. To a representative of this journal Prof. Elihu Thomson, consulting engineer of the company, said last week that the success which attended the demonstration on the Nahant feeder of the Lynn Gas & Electric Company marks an era of new possibilities in the field of remote control through the adoption of selectively tuned relay equipment to switch operation. While the company is not ready to publish the details of the equipment used, it may be said that the use of carrier current on the test circuits was accomplished by the employment of condensers between the service line and the apparatus at the transmitting and receiving points, and the frequency used was in the vicinity of 10,000 cycles. No vacuum tube was required at the receiving point, and this eliminates the necessity for continuous excitation. The receiving equipment embodied the major principles of radio relay design as developed by the General Electric Company for use in connection with the recent remote-control tests on the battleship Iowa. No antennas were used at Lynn. Professor Thomson pointed out that by the use of a large number of different frequencies the remote control of apparatus at numerous points could be commercially applied, with the advantage of localizing action at desired places, combining multiple and individual switch operations as required.

F. E. Chase, superintendent of the electrical department of the Lynn Gas & Electric Company, said that the success of these tests indicates the possibility of substantial future savings in the way of labor and of cable construction for central stations. There are many cases where the operation of street lamps from multiple circuits can be economically handled if the switching of these units is accomplished by carrier currents, as compared with the use of series circuits controlled from one point only.

Another Unit for Niagara Falls

IT IS reported that the Niagara Falls Power Company has placed an order for a 70,000-hp. turbine and a 65,000-kva. generator with the Allis-Chalmers Company. The turbine runs at 107.14 r.p.m. and is designed to operate on a 213-ft. head. The generator is rated at 12,000 volts, 25-cycle, three-phase.

Blackstone Valley Common Stock Offered on 7 per Cent Basis

LOW-PRICED bond issues of electric light and power companies have become a frequent occurrence, but stock issues, of course, to be made attractive have had to pay a higher rate. That the downward tendency in the price of money for public utility investment has reached stock issues too is shown in the recent offer of common stock of the Blackstone Valley Gas & Electric Company, which serves industrial communities in Rhode Island. This stock has a par value of $50, and the company has paid a dividend of 8 per cent on it since 1912, this dividend being increased to 10 per cent with the Dec. 1, 1921, payment. It is now offered at 71½. In other words, the purchaser will pay a premium of $21.50 per share and be content with a return of 7 per cent per annum.

T. H. Tutwiler May Head Reorganized Memphis Company

REPRESENTATIVES of the Electric Bond & Share Company of New York, which is soon to take over the control of the Memphis Gas & Electric Light Company, for many months in the hands of receivers, have been in the Tennessee city completing the arrangements. It is intimated that T. H. Tutwiler, formerly president and now one of the receivers of the local street railway, will head the reorganized utility.

Society for Electrical Development Elects New Directors

AT THE semi-annual meeting of the board of directors of the Society for Electrical Development, Inc., held on May 20, these directors were elected:

Representing Manufacturers—R. C. Lanphier, vice-president and general manager Sangamo Electric Company, Springfield, Ill., for one year to fill the unexpired term of W. D. Steele, resigned.

Representing Contractors—Walter H. Morton, secretary Sanborn Electric Company, Indianapolis, for four years, to fill the unexpired term of A. Penn Denton, resigned.

Representative-at-Large — Howard Ehrlich, president Electrical Trade Publishing Company, Chicago, for one year, to fill the unexpired term of Charles W. Price, who resigned as a director in the "at large" group.

Representing Affiliated Group — Charles W. Price, for four years, as the first director in the newly created affiliated group.

The board also ratified the previous action of the executive committee in accepting the resignation of L. A. Osborne as a director in the manufacturers' group and the election of Calvert Townley, assistant to the president Westinghouse Electric & Manufacturing Company, to fill the unexpired term, two years.

W. W. Freeman was re-elected president of the society and the same five vice-presidents were elected for the coming year, seniority being decided by lot, as follows: First vice-president, J. E. Montague; second vice-president, J. R. Strong; third vice-president, A. W. Burchard; fourth vice-president, Fred Bissell; fifth vice-president, J. R. Crouse. The present executive committee was re-elected with the substitution of Calvert Townley for Mr. Steele and Walter H. Morton for Fred B. Adam.

On May 9 the annual meeting of the society was held, at which the directors whose terms of office had expired were re-elected for four years, as follows: J. E. Montague, central-station group; L. P. Sawyer, manufacturers' group; Fred Bissell, jobbers' group; James H. McGraw, "at large" group, and A. Penn Denton, contractor-dealer group. Mr. Denton later resigned.

Ohio Men to Hold Varied Discussions at July Meeting

THE twenty-eighth annual convention of the Ohio Electric Light Association will, as already announced, be held at the Breakers Hotel, Cedar Point, Ohio, from July 11 to 14. The Tuesday morning session will be devoted to the presentation of committee reports. The entertainment features have been prepared in conjunction with the Ohio Electrical Contractor-Dealers' Association. An informal ball is scheduled for Thursday evening. The tentative program is as follows:

TUESDAY, JULY 11

Afternoon.—Report of transmission and distribution committee, by A. M. Wilson; "Co-operation," by Ward H. Snook, inspector for the Public Utilities Commission of Ohio.

WEDNESDAY, JULY 12

Morning.—Report of meter committee, by S. C. Henton; address by M. G. Lloyd, United States Bureau of Standards.

Afternoon.—Report of station-operating committee, by William Long; address by United States Senator Pomerene, Ohio.

THURSDAY, JULY 13

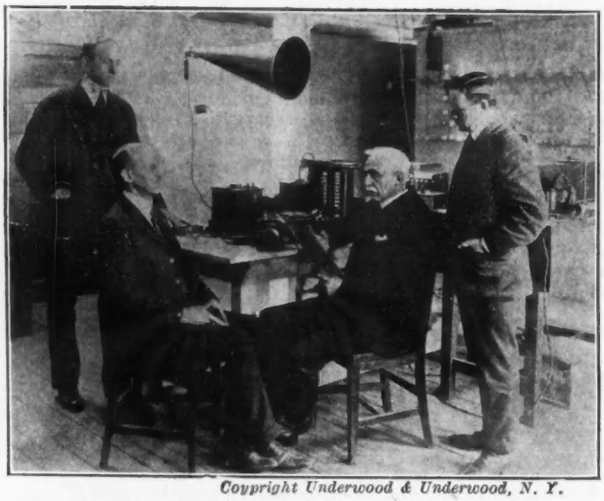
Morning.—Address by A. K. Baylor, member joint committee for business development, Schenectady, N. Y.; "Relation of the Manufacturer to the Merchandising Group of Business Men," by John J. Gibson, Pittsburgh.

Afternoon.—Address by Capt. Lawrence Davis, special representative National Contractor-Dealers' Association; address by Kenneth McIntire, special representative Society for Electrical Development.

FRIDAY, JULY 14

Morning.—Report of rural-service extension committee, by G. E. Miller; report on underground farm-line extensions; election of officers.

Tufts College Has Wireless College Faculty



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THIRTEEN of the leading members of the faculty of Tufts College have volunteered to give lectures on their subjects by wireless for the American Radio & Research Corporation plant. Four of them are, left to right, Dr. Arthur I. Andrews, who will speak on "Changes in Europe"; Prof. Edward H. Rockwell, "The Story of the Bridge Builders"; Dean Gardner C. Anthony, "The Story of Engineering," and Prof. Albert H. Gilmer, "The Modern Drama."

Seattle's Cedar Falls Plant Has Narrow Escape from Destruction.—In a recent fire that swept Cedar Falls, Wash., the quarter-million-dollar hydro-electric plant of the city of Seattle had a narrow escape from destruction, being saved only by the determined work of the Seattle firemen.

Squirrels Short-Circuit Power Line.—Manager Thomas M. Cougevan of the Canandaigua branch of the Rochester Gas & Electric Corporation has recommended the installation of large tin collars on poles in the new power line between Rochester and Canandaigua to prevent gray squirrels from causing damage to the wires. Mr. Cougevan's recommendation followed the discovery that a recent short circuit on this line had been caused by an adventurous squirrel which had investigated the aërial system with fatal results to itself.

Work on New Plant of Counties Gas & Electric Company Begun.—Work on the erection of the first unit of a steam-power plant on Barbadoes Island, in the Schuylkill River, opposite Norristown, Pa., to supply power for the fast-growing load of the Counties Gas & Electric Company, has been begun by the United Gas Improvement Contracting Company of Philadelphia. The immediate installation will consist of one turbo-generator of 25,000 kva. rating, with condensers, boilers and all other necessary apparatus. Ultimately the plant is to have a capacity of 125,000 kva.

Eastern Wisconsin Electric Company Purchased by Middle West Utilities.—The Middle West Utilities Company announces that it has acquired the Eastern Wisconsin Electric Company of Sheboygan. The total population served by this company is estimated at 110,000 and its gross annual revenue is in excess of $1,500,000. Announcement also has been made that the Wisconsin Power, Light & Heat Company of Madison will immediately construct a 66,000-volt high-tension transmission line extending from Dane through Columbus and Beaver Dam to Fond du Lac, a distance of 75 miles.

French and American Engineers Fraternize at Washington.—Ambassador Jusserand recently gave a dinner at Washington to a group of leading American engineers at which the harmony existing between French and American engineers was praised and plans for future co-operation and mutual furtherance of world peace were discussed. Secretary Hoover was the toastmaster at the dinner, at which the speakers were Ambassador Jusserand, M. Aimé Dumaine, representative of the Creusot Works in America and president of the American section of the Society of Civil Engineers of France, and Ambrose Swasey of Cleveland, founder of the Engineering Foundation, who is an officer of the Legion of Honor. Dr. William McClellan, president. and F. L. Hutchinson, secretary of the A. I. E. E. were guests.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest

Indiana & Michigan Electric Company Expands.—The Indiana & Michigan Electric Company has started work on an expansion of its South Bend (Ind.) power plants and has awarded contracts for $1,250,000, which will result in the generation of 15,000 hp. in addition to that now supplied.

People to Decide When Engineers Disagree.—Directly contradictory reports have been rendered by two engineers employed respectively by the Modesto and the Turlock irrigation district in Stanislaus County, central California, the former recommending that the districts sell the electrical energy generated by them at the Don Pedro dam wholesale to the Pacific Gas & Electric Company, and the latter that the districts build a power house and distribution system and retail the energy themselves. It is probable that the voters will be called upon to decide between the two propositions.

Employees at Hawthorne Listen to Speeches Made in New York and San Francisco.—Speaking from New York to the employees of the Western Electric Company's Hawthorne plant at Chicago last week by means of loud-speaking apparatus, Dr. Frank B. Jewett remarked that it was the first time he had been able to talk with all his co-workers simultaneously. Addresses were also given by Charles G. Du Bois, president of the Western Electric Company, and Harry B. Thayer, president American Telephone & Telegraph Company, both speaking from New York. J. C. Nowell, vice-president Pacific Telephone & Telegraph Company, addressed the gathering from San Francisco. The radio set used has a possible amplification of eighteen and three-quarter billions. Six loud-speaking receivers were used.

Mississippi Valley Power Company Takes Over Transmission System in Arkansas.—The Mississippi Valley Power Company, recently organized, is now operating approximately 60 miles of 33,000-volt and 13,200-volt transmission lines from Alma to Clarksville and Paris, Ark., formerly owned by the Commonwealth Public Service Company, and will assume ownership of these properties on July 1. It will also acquire distributing systems at eleven other towns in Arkansas and will serve the customers in these towns at retail. The company purchases energy under a twenty-five-year contract from the Fort Smith Light & Traction Company. The transmission lines operated by the Mississippi Valley Power Company will form part of the transmission system connecting Fort Smith with the proposed plant of the Oklahoma General Power Company at Muskogee, Okla. Construction work on this station will be started at an early date, and its initial capacity will be 10,000 hp.

Pacific Power & Light Company to Build Plant.—The Pacific Power & Light Company, with headquarters at Portland, Ore., has announced that a contract has been awarded to the Phoenix Construction Company of Portland to build the Pacific company's hydro-electric plant at Hood River, Ore., at a cost of about $1,250,000. This plant will have a total capacity of 7,500 kw. Water will be diverted from Hood River by a dam and conducted to the power plant through a pipe line 2½ miles in length. Work is to begin at once, and it is expected that the plant will be completed by February, 1923. The Northwestern Electric Company of Portland will, it is stated, purchase a 3,000-kw. block of the power to be generated.

Associations and Societies

Empire State Gas and Electric Association.—A meeting of the Commercial Section of this association will be held at the Fort William Henry Hotel, Lake George, on Thursday and Friday, June 29 and 30.

Geographic Division Meetings, N. E. L. A.—The Rocky Mountain Division of the N. E. L. A. is to hold its annual convention at Glenwood Springs, Col., beginning Sept. 18. The second annual convention of the Great Lakes Division will be held at French Lick Springs, Ind., on Sept. 28-30.

Radio Club of America.—A special meeting of the Radio Club of America will be held on Wednesday, June 28, at 8:15 p.m., in Room 306, Havemeyer Hall, Columbia University, New York City. Major E. H. Armstrong will read a paper on "The Super-Regenerative Circuit," his latest invention, and actual demonstrations of the new circuit will be given, with lantern slides.

Coming Meetings of Electrical and Other Technical Societies

A. I. E. E. Annual Convention — Niagara Falls, Ontario, June 26-30. (For program see issue of June 17, page 1240.)
American Society for Testing Materials—Atlantic City, N. J., June 26-July 1.
National Council Lighting Fixture Manufacturers—Cleveland, June 28-29.
Ohio Electric Light Association — Cedar Point, Ohio, July 11-14. (For program see "News of the Industry.")
A. I. E. E., Pacific Coast Convention—Vancouver, B. C., Aug. 8-11.
International Association of Municipal Electricians — New Bedford, Mass., Aug. 22-25.
N. E. L. A. Geographic Divisions—New England, New London, Conn., Sept. 5-7; Rocky Mountain, Glenwood Springs, Col., Sept. 18; Great Lakes, French Lick Springs, Ind., Sept. 28-30.
Association of Iron and Steel Electrical Engineers—Cleveland, Sept. 11-15.
American Electrochemical Society — Montreal, Sept. 21-23.
Illuminating Engineering Society—Boston, Sept. 25-28.
National Association of Railway and Utilities Commissioners—Detroit, Sept. 26.
Telephone Pioneers of America—Cleveland, Sept. 29-30.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Contributory Negligence a Question of Law When There Is No Dispute About Facts.—Instructions to the jury favoring the defendant in a damage suit involving the question of contributory negligence where there was no dispute over the facts have been sustained by the Court of Appeals of Kentucky (McMurtry's Administratrix vs. Kentucky Utilities Company). In this case a telephone lineman was killed while reaching over high-voltage wires which, by mutual arrangement between a power company and the telephone company, occupied the same poles on which the lineman had to work. Although the court found that the power company was bound to exercise the highest degree of care to keep its lines safe for workmen, the undisputed facts that the lineman was aware of the uninsulated condition of the wires by contact with which he was killed, and that he took the course he did against the protest of other members of the crew, and that there were other and safe methods by which he might have proceeded to perform his task, prevented any recovery for his death. (239 S. W. 62.)*

Why a Service Charge Is Not Rent.—In its decision declaring a service charge to be legal (City of Rochester vs. Rochester Gas & Electric Corporation; see issues of March 11, page 500, and March 18, page 552) the Court of Appeals of New York thus discriminated between such a charge and the rent of meters forbidden by the law: "Rent is the periodic return for the privilege of use. The rental value of a machine when capitalized for a term which varies with durability of use is equal to the capital value of the price. There may, of course, be rents that will not yield a profit. None the less, profit within the limit of capacity is typically and normally the end and aim of the exaction. . . . We do not say that a charge, however small, may not be rent within the statute if imposed with that intention and under an agreement that it shall be so regarded. The measure of the charge and the mode of computation are none the less relevant considerations when the question is whether a burden imposed under another name and ostensibly for a different purpose is merely rent in disguise. The Legislature in forbidding rents must be presumed to have had in view the typical and normal. Here the burden of the consumer, so far as affected by the meters, is limited to the cost of installation and repair. The charge is not intended as an equivalent for the value of the use. It is compensation for expenses that must be incurred to put the meters in such a condition that the use may be enjoyed. True it is that the individual must pay his monthly quota though his own meter has been neither changed nor repaired during the month, just as he must pay his quota for the maintenance of service pipes and their accessories though his own may have remained intact. In the long run, however, and on the average, what he pays is counterbalanced by what he receives." (134 N. E. 834.)

United States Supreme Court Again Rules on Confiscation.—Findings of the United States District Court for southern Texas and of a special master in a suit brought by the city of Houston against the Southwestern Bell Telephone Company to the effect that the rates to which the city strove to hold the company were confiscatory have been affirmed in a decision just handed down by the United States Supreme Court. In this case the district court and the master, while agreeing on the point of confiscation, disagreed over a merger ordinance of 1915 which contained the provision that the company "agrees that it will not increase rates as at present charged by it for service in the city of Houston unless it appears upon a satisfactory showing . . . that there exists a necessity for an increase of charges, in order that the said company may earn a fair return upon its capital actually invested in the Houston plant." The master sustained the contention of the company that this clause controverted the Constitution of Texas, which provides that "no irrevocable or uncontrollable grant of special privileges or immunities shall be made, but all privileges and franchises granted by the Legislature or created under its authority shall be subject to the control thereof." The district court disagreed and held that the company, having accepted the clause, was obliged by it to accept the cost of its physical plant as the basis for rate making, instead of the value of the property used and useful in operating the plant at the time of the inquiry. The Supreme Court declares that the lower court was in error in so ruling and that the provision of the ordinance in question was invalid. On the question of "going concern" value, which was also involved, the Supreme Court referred to its recent decision in Galveston Electric Company vs. City of Galveston (see ELECTRICAL WORLD for April 29, page 852), reiterating that whether going concern value should be considered and allowed at all in determining the base for rate making, and if allowed what the amount of it should be, depends upon the financial history of the company, but declining in this case to make a specific ruling because briefs had not been prepared to save the court from reading a transcript of more than 1,600 pages.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Why Street Lighting Is Entitled to Lower Rate than Other Lighting Business.—The fact that a village pays in one check for electricity used for street lighting, thereby obviating the necessity for reading a large number of meters, making out and collecting numerous bills and the occasional losses through inability to collect, is, the North Dakota Board of Railroad Commissioners pointed out in passing upon an application for increased rates made by the Gackle Light & Power Company, the reason street lighting should pay a lower rate than general lighting.

Capitalization and Depreciation Reserve.—Granting conditional permission to the Ojai Power Company to issue additional securities, the California Railroad Commission declared that it cannot authorize issues to reimburse the treasury of a public utility company for moneys expended for additions and betterments when such moneys were obtained from the sale of other property and when no reduction was made in the capitalization of the company at the time the property was sold. A public utility company, it further observed, should not be allowed to use the proceeds from the sale of its stock to provide an adequate depreciation reserve with which to make additional extensions from time to time, since the primary function of a depreciation reserve is to take care of replacements and such reserve should be built up from earnings.

Service Rates for Mine-Hoist Motors.—The Public Utilities Commission of Utah has authorized amendments to the rules of the Utah Power & Light Company to determine the power consumed in the operation of mine hoists. Under these changes, which have been agreed to by the mining interests, it is provided that where hoist motors are used the maximum demand shall be the highest average five-minute load taken by the consumer, no additional charge being made for motors hoisting on inclines where an average gradient of less than 45 deg. exists. Where motors hoisting on inclines having an angle of 45 deg. or more are used the maximum demand shall be the highest of the combined continuous load ratings of all hoist motors multiplied by the fraction obtained by dividing the said average gradient by 90 plus the highest average five-minute load. The contract horsepower under other charges shall be the monthly maximum demand, but shall not be less than that now contracted for.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Don C. Shafer, advertising manager of the International General Electric Company and well known in advertising and literary circles, has resigned his position and will devote himself to literary work. Mr. Shafer left newspaper editorial work in 1906 to take up

D. C. SHAFER

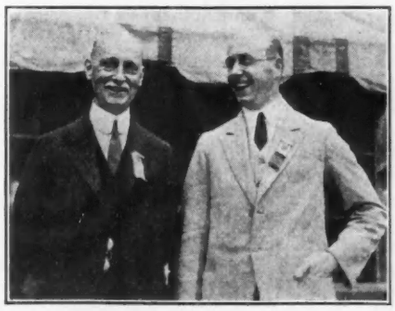
advertising and publicity work, joining the advertising department of the General Electric Company in that year. When the International General Electric Company was organized he was appointed advertising manager. In the electrical field Mr. Shafer has been an active factor in the work of educating the public to the value and desirability of electricity and electrical devices in the home. Through magazine and newspaper articles he has helped popularize the use of electricity.

D. H. Braymer, who has served successively as engineering editor, managing editor and coeditor of the ELECTRICAL WORLD, is now devoting all of his time to the *Electrical Review and Industrial Engineer,* formerly the *Electrical Review,* which was purchased by the McGraw-Hill Company last winter. He has been made publishing director as well as editorial director of the new paper, with headquarters in Chicago at 1570 Old Colony Building. This present activity of Mr. Braymer is the direct outcome of his interest and work in connection with the industrial side of electrical engineering. He is the author of a book on armature winding which has proved very popular in the industrial field and he has done much to make the ELECTRICAL WORLD serve the industrial electrical engineer.

On account of the fact that his entire attention is now devoted to the *Electrical Review and Industrial Engineer* he is discontinuing his official position as editor of ELECTRICAL WORLD, effective July 1.

Harold V. Bozell, who has been for the past two years coeditor of the *Electric Railway Journal* and more recently editor of the new McGraw-Hill publication *Bus Transportation,* has been appointed an editor of the ELECTRICAL WORLD in executive charge of the paper. He has been acting as the managing editor of the ELECTRICAL WORLD for the past few months. He will retain a connection with the *Electric Railway Journal* and *Bus Transportation* as consulting editor. Mr. Bozell by this move returns actively to the electrical field. From 1908 to 1916 he was head of the department of electrical engineering at the University of Oklahoma, during which time he was also active in the field of consulting engineering in that state. He organized and served as secretary of the Gas, Electric and Street Railway Association of Oklahoma, now the Public Utilities Association of Oklahoma. From 1916 to 1921 he was assistant professor of electrical engineering at Yale University and during the war was quite active both in supervising the training of technical signal personnel for the army in various colleges and in conducting engineering developments on special problems for the Naval Consulting Board. At Yale he specialized in courses in public utility engineering and management. In 1920, while retaining a part-time connection with Yale, he joined the *Electric Railway Journal.* He is a native of Kansas, a graduate of the University of Kansas, a member of the A.I.E.E., the I.E.S. and the S.P.E.E.

Frank W. Smith, vice-president and general manager of the United Electric



F. W. SMITH AND H. DEWES

Light & Power Company of New York City, and newly elected president of the National Electric Light Association, was one of the prominent guests at the recent convention of the Pacific Coast Electrical Association at Los Angeles, as well as one of the speakers on the convention program. He brought a message of confidence and support from the national association to the Pacific Coast organization. The gentleman with Mr. Smith is **Herbert Dewes,** assistant to the vice-president and general manager of the Southern Sierras Power Company, general chairman of the convention. Much of the success of the gathering was due to the tireless efforts of Mr. Dewes in directing the many committees charged with the arrangements and the entertainment of guests and delegates.

J. Elmer Housley has been appointed sales engineer of the Aluminum Com-

J. E. HOUSLEY

pany of America, with headquarters in Kansas City, Mo. Mr. Housley will specialize in the sale of aluminum electrical conductors. He was born in Knoxville, Tenn., Jan. 9, 1893, and was graduated from the University of Tennessee in 1915 as electrical engineer. After graduation he entered the engineering apprentice course of the Aluminum Ore Company and in 1915 he was placed in charge of motor testing, metering and record systems for that company. In 1917 he was in turn construction foreman and shop foreman in the electrical department of the same company and in 1918 entered the engineering department to handle its electrical problems. In 1919 he was appointed electrical engineer, having complete charge of construction and maintenance in the electrical work. During 1921 he also took over the complete power-house operation in connection with the electrical work. Mr. Housley has contributed extensively to the technical press.

James M. Wakeman, formerly general manager of the Society for Electrical Development, Inc., and well known in the electrical industry, has just returned to his home in East Orange, N. J., from an eight months' trip in Europe. Shortly after he resigned from the S. E. D. Mr. Wakeman, sailed for England in search of rest and recreation. That he found both

is evident from his appearance. Questioned as to his future plans, Mr. Wakeman would give no inkling other than that they would be announced when completed.

J. G. Barry, sales manager of the General Electric Company since 1917 and manager of its railway department for many years, was recently elected a vice-president of the company. Mr.

J. G. BARRY

Barry has been connected with the General Electric and Thomson-Houston companies for thirty-two years. He is fifty-two years old. He was first employed in the production department of the Thomson-Houston company in Lynn, Mass., in 1890. A year later he was transferred to the construction department of the Boston office and in 1894 entered the railway department at Schenectady, following the organization of the General Electric Company. Mr. Barry worked up to the position of assistant manager of this department in three years, and in 1907 was appointed manager, in which position he exerted a marked influence on many aspects of the company's sales problems and policies. His success as manager of the railway department led to his appointment in 1917 as general sales manager and his present promotion to vice-president.

Randolph M. Mann has become connected with the Betts & Betts Corporation as assistant sales manager and will make his headquarters in New York City. He comes to this position after about twenty-seven years in the electrical construction and manufacturing industry. Mr. Mann began his career with the General Electric Company in 1895 and continued with this company for the following ten years. He then became connected with the Metropolitan Engineering Company as general manager, and when this concern ceased the manufacture of electric signs he went with the Federal Sign System at New York and was later transferred to its Minneapolis office, where he became district manager. In May, 1918, he entered the government service as industrial expert for the United States Ordnance Department in the safety and sanitation branch, ranking as first lieutenant. After discharge from the army in 1919 he entered the employ of the Electric Service Supplies Company of Philadelphia as manager of the New York branch, which position he held until his present connection with the Betts & Betts Corporation.

George P. Prichett has been appointed resident engineer in Philadelphia for the National X-Ray Reflector Company, Chicago.

Henry Joseph has been elected president of the Joart Electric Company, which has been recently incorporated in Los Angeles for the purpose of manufacturing and merchandising Joart electric washing machines. Mr. Joseph is the owner of the patent of the machines to be manufactured.

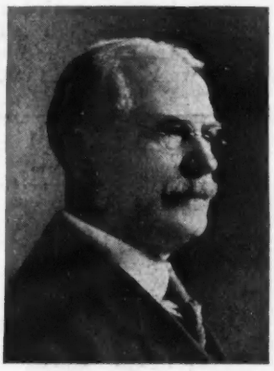
Otis L. Thompson has been elected president of the Casper Electric Supply Company, which has been recently organized at Casper, Wyo., to carry on a wholesale and retail general electrical contracting and construction business and to handle electrical supplies and appliances of all kinds.

A. A. Brown, assistant to the sales manager of the Westinghouse Electric & Manufacturing Company, has been appointed manager of syndicate operations for that company. Mr. Brown entered the employ of the Westinghouse Machine Company as a salesman in its Pittsburgh office in 1904, and later was transferred to and placed in charge of the Cincinnati office. In 1907 he became Pittsburgh representative of the Westinghouse, Church, Kerr Company, and in 1909 he took a position in the sales department of the Westinghouse Electric & Manufacturing Company. In 1911 he was made assistant to the sales manager.

H. W. Kilkenny of the Tubular Woven Fabric Company has taken over the districts of Detroit and Michigan in addition to his present supervision of the districts of northern Ohio, northern Indiana and western New York.

Edgar Switzer is the vice-president and general manager of the recently incorporated Manufacturers' Electrical Corporation, Chicago, which will act as manufacturers' representative throughout the Middle West. After attending the electrical engineering course at Lewis Institute Mr. Switzer joined the Commonwealth Edison Company in 1900. Several years later he was connected with the engineering department of the North Shore Electric Company, which was later absorbed by the Public Service Company of Northern Illinois. In 1905 he went with the J. Lang Company as sales engineer and remained there until it was absorbed by the George Cutter Company. Then he became connected with the Stare Electrical Company as sales manager and supervised the importation of various lines of electrical specialties of European manufacture. In 1912 he joined the Westinghouse company, where he remained as syndicate representative until the formation of this new distributing company.

C. F. McGilvray has resigned as president of the Robbins & Myers Company, Springfield, Ohio, to become chairman of the board of directors, his place as president being filled by F. S. Hunting. Mr. McGilvray has been with the Rob-



C. F. McGILVRAY

bins & Myers Company for many years and as president built the company up to a point of eminence in the production of fans and small motors.

Obituary

George G. Ward, vice-president and general manager of the Commercial Cable Company, who was regarded as the dean of the submarine cable engineers, died on June 15 in New York City. Mr. Ward was an Englishman, born Dec. 30, 1844, at Great Hadham, Hertfordshire. Upon leaving school he entered the employ of the Electric Telegraph Company, and in 1865 was sent to Alexandria on telegraph service for the Egyptian government. In 1869 he joined the French Atlantic Cable Company and was assigned to the steamship Great Eastern as a member of the electrical staff during the laying of the company's cable. Later he was superintendent of the Direct United States Cable Company and in 1884 became the general manager of the Commercial Cable Company. He was elected vice-president of that company in 1890 and continued in this position until his death. Mr. Ward was a director of the Commercial Company of Cuba, the Commercial Pacific Cable Company, the Mackay companies, the National Surety Company, the Postal Telegraph Cable Company, the United State & Haiti Telegraph & Cable Company and the United States Mortgage & Trust Company.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Sales of Hollow-Ware Are Reported Increasing

SALES of hollow-ware in Southern districts are, in general, on the increase, electric flatirons and percolators being the principal sellers. Chafing dishes are slower than for some time past, with water heaters also rather sluggish. Curling irons and grills continue to grow in popularity. It is hard to put a percentage increase on these sales as the movement has been somewhat spasmodic.

In the Western district a special flurry of trade has been in evidence for several weeks past, gifts for the June bride occasioning the demand. Aside from this seasonal sale, the hollow-ware market is sluggish. Stocks are in good condition.

Non-English-Speaking Countries Sent 70 per Cent of Canada's Lamp Imports

THAT 70 per cent of the lamps imported into Canada for nine months ended Dec. 31, 1921, were imported from non-English-speaking countries is the outstanding feature of a table on lamp importations into Canada for consumption as supplied by the external-trade branch of the Dominion Bureau of Statistics. The largest number of lamps imported from any one country was from the Netherlands, with the United States coming second. The importations from Japan were apparently on the decline as shown in the following table:

IMPORTS OF ELECTRIC LAMPS INTO CANADA FOR CONSUMPTION

	—Nine Months Ended Dec. 31—			
	1920		1921	
	No.	Value	No.	Value
Lamps, electric, arc:				
United States	.....	$20,403	.....	$17,301
Lamps, electric, incandescent:				
United Kingdom	18,111	6,249	112,216	19,355
United States	2,972,228	867,707	551,049	121,275
Austria	864	195	7,379	882
Belgium	.....	.....	138,830	60,321
Czecho-Slovakia	.....	.....	18,022	1,733
France	303	277	5,871	1,014
Germany	.....	.....	50	119
Hong Kong	10	4	204	75
Japan	735,057	54,793	386,676	27,909
Netherlands	527,619	88,577	1,039,552	192,875
Switzerland	.....	.....	6,707	1,607
Total	4,254,192	1,017,802	2,266,556	427,165

Freight Traffic for Four Months of 1922 Gained 5.7 per Cent

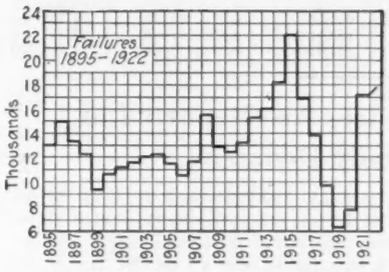
IN SPITE of the coal strike, the railroads during the first four months of this year have carried 5.7 per cent more freight traffic than they did during the corresponding period last year. In April of this year, the month in which the strike began, the net ton-miles totaled 24,709,000,000, which is a decrease of 857,000,000 miles, or 3.4 per cent, compared with April, 1921. But in the first four months of this year the net ton-miles have amounted to 113,252,000,000, which is an increase of 6,125,000,000 miles over the same period last year.

The passenger reports of the Interstate Commerce Commission show a decrease of 15.5 per cent in passenger travel in March, compared with the same month last year. On the basis of revenue passenger miles, the total in March was 2,592,731,000, compared with the 3,069,779,000 in the same month last year.

For the three-month period ended March 31, this year, revenue passenger miles totaled 7,693,255,000. This is a decrease of 1,328,610,000, or 17.8 per cent, compared with last year.

Business Failures Show Decided Decrease from Previous Week's Figures

FAILURES reported in the United States for last week number 407, showing a decided decrease from the figure for the previous week, when 440 defaults were reported to R. G. Dun & Company. Last week's number is nearer the record for the corresponding week a year ago, when 329 defaults were reported.



BANKRUPTCIES FROM 1895 TO JUNE, 1922

Of last week's insolvencies 231 involved $5,000 or over in each instance, that number being 56.7 per cent of the total defaults. In the previous week, although the number of failures with liabilities of $5,000 or more in each instance was greater, being 243, the percentage was slightly lower, or 55.2, while a year ago similar defaults numbered 171, being 51.9 per cent of that week's total.

Canada's failures, however, show an increase from fifty-five week before last to sixty-one last week. In the corresponding week a year ago they were only thirty-seven. Of the current Canadian defaults, thirty had liabilities of $5,000 or more in each case, compared with twenty-nine a week ago.

New York City Has Shortest Factory Week in United States

THE number of manufacturing establishments in New York City increased 10 per cent from 1914 to 1919 and 13 per cent in the number of persons employed, according to a report to the industrial bureau of the Merchants' Association.

Factory workers in New York City work fewer hours a week than those employed in up-state factories or in manufacturing establishments throughout the country, the same report shows. The figures were obtained from data furnished by the New York State Department of Labor and are based upon 593 reports, covering a total of 98,032 factory employees.

The working week of 26.5 per cent of New York City factory workers is forty-four hours or less, while in New York State only 3½ per cent of the employees work the short week. Taking the country as a whole, more than 25 per cent of the factory workers work more than fifty-four hours a week and about an equal number work forty-nine to fifty-four hours. Only 12.2 per cent are employed for a work week of forty-four hours or less.

Bank Clearings Gain 9 per Cent Over Same Week in 1921

THE more favorable exhibits of weekly bank clearings continue, an aggregate of $6,900,365,000 at twenty cities in the United States, as reported to *Dun's Review*, representing an increase of 9 per cent over the $6,332,502,817 of a year ago. There is a reduction, however, of 11.9 per cent from the total for this week of 1920. Comparing with last year, decreases appear at Philadelphia, Atlanta, Cincinnati, Cleveland, Minneapolis and Kansas City, the losses ranging from 0.8 per cent at Atlanta to 7.4 per cent at Kansas City; but these changes are more than offset by gains at other cities, which range from 3.2 per cent at Dallas to 27 per cent at Boston.

Average daily bank clearings for June to date and for preceding months are compared herewith for three years:

	1922	1921	1920
June	$1,158,439,000	$1,030,496,000	$1,284,749,000
May	1,143,911,000	982,676,000	1,331,217,000
April	1,115,478,000	957,996,000	1,321,113,000
March	1,042,360,000	975,088,000	1,321,007,000
February	1 052,112,000	1,060,726,000	1,322,870,000
January	1,087,235,000	1,190,774,000	1,374,249,000
	1921	1920	1919
December	$1,095,600,000	$1,255,276,000	$1,409,930,000
November	1,091,856,000	1,291,574,000	1,444,048,000
October	1,070,232,000	1,343,698,000	1,392,663,000
September	969,200,000	1,214,388,000	1,351,396,000
August	877,464,000	1,135,201,000	1,192,969,000
July	981,185,000	1,264,155,000	1,278,856,000

Wiring Devices Are Reported in Steady Demand

CONTINUED improvement, slow though it may be in some factories, is reported in the wiring-device field. Building activities in various parts of the country are beginning to pull upon accumulated stocks in the hands of jobbers, and while nothing like a boom is being felt by manufacturers of sockets, switches and related supplies, the tone of business is far better than a few months ago. In some quarters a lull in demand has been experienced during the past two or three weeks, but this is not believed to be any serious curtailment of the general upward trend.

Orders have been coming in well for heavy-duty switches such as are used in electric range service and for small-motor operation in machine-shop work. Some of these orders have come from France and Norway. Wages in most plants are still above pre-war levels, but in some cases adjustments have brought the average down to 10 to 25 per cent over the figures of 1913.

Manufacturers are now able to buy brass on terms much more acceptable than prevailed during the war period, and pretty much all of the high-priced raw material of that time has been worked into finished product now and in general moved out of the factory. Wide differences exist still among manufacturers as to the maintenance of factory stocks of wiring devices, but more or less production for stock will undoubtedly occupy manufacturers this summer in anticipation of still larger sales next fall. One plant has taken on over 200 employees within the past three weeks.

Cost of Living for May Higher in Most Groups of Commodities

FIGURES compiled by the Bureau of Labor Statistics of the Department of Labor indicate that the cost of living continues to rise. In all groups of commodities except chemicals and drugs the level of wholesale prices in May averaged higher than those in April. Farm products, food, clothing, fuel and lighting, metal products, building materials and most commodities reached higher price levels in May than during the previous months, and in a number of groups the prices were higher than during the corresponding month in 1921.

The department endeavors to show the relative difference between wholesale prices from month to month by a series of index numbers. These are being continually revised to show the fluctuating changes in price levels. The revised index numbers for the several commodity groups for May, 1921, as compared with those for April and May, 1922, are as follows:

	May, 1921	April, 1922	May, 1922
Farm products	118	129	132
Foods	138	137	138
Clothes and clothing	173	171	175
Fuel and lighting	200	194	216
Metals and metal products	138	113	119
Building materials	165	156	160
Chemicals and drugs	134	124	122
House furnishing goods	209	175	176
Miscellaneous	128	126	116
All commodities	145	143	148

Copper Consumption in 1922 May Reach 1,900,000,000 Lb.

WORLD'S consumption in 1922 of new copper will probably approximate 1,900,000,000 lb. and may equal 2,000,000,000 lb., government statistics indicate. This is at an average of 160,000,000 lb. a month, compared with an indicated 1921 world consumption of approximately 1,750,000,000 lb., or 145,000,000 lb. a month.

Including orders for future delivery, sales of copper metal for May will exceed the total of any month in the last two years, according to trade estimates. The greater part of the orders placed for future delivery call for shipments during the current month and in July, and some for August delivery. The Copper & Brass Research Association some time ago discontinued furnishing statistics on sales even to its members, consequently no official figures are now obtainable.

Weekly Metal Market Situation

FOREIGN and domestic buying of copper remains small, as is to be expected between domestic buying movements when foreign buyers are uncertain regarding developments in European politics. Prices remain firm, with no disposition on the part of any producers to press the market.

As sales during recent weeks have been large enough to keep shipments from all companies at a good rate, it is believed that money coming in will be ample to meet all requirements, no matter if consumers stay out of the market for some time. It is therefore thought that prices will hold at present level with possibly ⅛-cent recession until the next buying movement begins.

Price of electrolytic copper for domestic shipment is 14 cents a pound delivered for June, July and August, with a small amount of second-hand metal available at around 13⅞ cents. Price of lake copper is 14 cents for the same months. Price alongside ship New York is 13⅞ cents for June, July and August, with price at 13.90 cents to 14 cents at Tacoma for the same months.

NEW YORK METAL MARKET PRICES

Copper:	June 14, 1922	June 21, 1922
London, standard spot	£ s. d. 63 2 6	£ s. d. 63 2 6
	Cents per Pound	Cents per Pound
Prime Lake	14.00	14.00
Electrolytic	13.75	13.62½
Casting	13.37½	13.37½
Lead, Am. S. & R. price	5 75	5.55
Antimony	5.12	5.05
Nickel, ingot	36.00	36.00
Zinc, spot	5.75	5.70
Tin, straits	31.25	31.37½
Aluminum, 98 to 99 per cent	19.10	19.10
OLD METALS		
Heavy copper and wire	11.00 -11.50	11.00 -11.50
Brass, heavy	5.50 - 6.00	5.50 - 5.75
Brass, light	5.00 - 5.25	5.00 - 5 12½
Lead, heavy	4.70 - 4.75	4.62½- 4.70
Zinc, old scrap	3.00 - 3.12½	3.00 - 3.12½

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

HEAVY demand for fans, the hot weather having given the necessary stimulus, is one of the principal features of this week's electrical market. Steady prices prevail and few attempts at underselling are reported.

High-tension equipment manufacturers report good business with steady orders.

Lamp demand is holding up its curve started during the winter months. Dealers attribute this to the entrance of buyers from the railroad and industrial field.

Jobbers report a good market for automobile battery sales. Prices are reported steady, although one leading manufacturer is scheduled to reduce his quotations about 10 per cent on July 1.

Building activity, as previously noted, has created a steady call for wiring materials, and jobbers generally are realizing on this business. Orders from industrial customers continue to come through, and although most of the material is for renewal and maintenance work and minor extensions to plants, it is a good indication of the confidence of industry in the general business situation.

Motor sales are considered spotty with prices firm. Considerable manufacturing in this line is now in progress to build up agency stocks.

NEW YORK

The demand for electrical material and supplies has been steady for the past week without any particularly noteworthy features. Some jobbers report a slight increase in sales, while others report that a few items have fallen off. There have been no important price changes, and the market has the appearance of having settled down for the summer.

Rigid Conduit.—No change in prices or demand for this material was noted. Jobbers report that sales are only moderate, and prices still show quite a variation. Quotations this week were as follows: For ½-in. black pipe in 2,500-ft. lots, $44.50 to $46.58; ¾-in., $58.10 to $59.57, and 1-in., $82.79 to $84.66 per 1,000 ft. Quotations on galvanized pipe in the same sizes and quantities were $50 to $51.68, $64.50 to $66.47 and $92.20 to $94.88 per 1,000 ft.

Rubber-Covered Wire.—Prices have stiffened somewhat, although the demand for the smaller sizes is rather sluggish. The larger sizes are being bought in increasing quantities by industrial users and seem to be intended for maintenance and renewal work. No. 14, rubber-covered, single-braid, is quoted from $6.25 to $6.50 per 1,000 ft. in 5,000-ft. lots.

Flexible Armored Conductor.—Armored conductor continues to move steadily without any indication of a change in price. No. 14, two-wire, single-strip, is quoted at $43 per 1,000 ft., and double-strip at $45 per 1,000 ft. for that quantity.

Sockets.—In line with other wiring supplies, sockets are in fairly steady demand. In standard-package lots full sockets sell for 33 cents, key sockets for 18 cents and keyless for 16 cents each.

Loom.—Demand is usually light and only small stocks are carried. In coil lots the ⅜-in. size sells for $16.50 per 1,000 ft. and the ½-in. size for $18 per 1,000 ft.

Dry Cells.—In barrel lots No. 6 regulars are quoted at $29 per 100 and igniters at $30 per 100. Demand is fair and stocks are good.

Tape.—In 25-lb. lots friction and rubber tape are quoted at 36 cents per pound.

Fans.—Jobbers are well satisfied with the volume of fan business thus far and expect a fairly active demand for the next month or six weeks.

Appliances.—Heating devices are moving slowly, but there has been some increase in the sales of electric washers and ironing machines. Active demonstrations by manufacturers have helped to stimulate this business.

CHICAGO

Conditions in the electrical market have changed but slightly during the week. The previous activity on wiring materials has been maintained, although prices have varied according to the rating of the purchaser. Manufacturers of high-tension equipment found the week to hold some good business, since sales were steady. The lamp demand has practically held up its curve started during the winter months. Dealers attribute this to the entrance of buyers from the railroad and industrial field. While the radio demand has fallen off somewhat, well-established jobbers are not worrying but are studying the future in anticipation of a brisk fall business.

During the week the Chicago Mail Order Company announced plans for the erection of a four-million-dollar factory on the corner of Jackson Boulevard and Rockwell Street, which will measure 275 ft. x 465 ft. This project will be built in units—the first calling for an eight-story building costing about $1,000,000.

Conduit.—Sales on conduit are steady and prices vary from $43 to $45 per 1,000 ft. for the ½-in. black pipe. Although stocks on this size have been lowered by the demand for building, jobbers report that shipments during the week from manufacturers have again brought their supplies up to normal.

Wire.—The call for rubber-covered wire is still good and prices are quoted between $6.10 and $6.20 per 1,000 ft. for No. 14 in 5,000-ft. lots. The supply is quite uniformly distributed among jobbers. Quotations on the bare and weatherproof wire range from 16½ cents to 17 cents per pound and the demand is fair.

Flexible Armored Conductor.—Dealers state that this material is again going steadily at prices around $43 per 1,000 ft. for the No. 14 two-wire single-strip. Stocks are sufficient to supply local demands.

High-Tension Equipment.—Another week of steady activity in this line was reported by the majority of manufacturers. One firm received orders for one 1,200-kva., 33,000-volt steel-tower outdoor substation for the Middle West and two 600-kva., 13,200-volt substations for the Northwest.

Lamps.—Although a slight slump has been felt in this market, the majority of dealers report that the level of buying established during the winter has been fairly well sustained to date. Most of them attribute this to the fact that the industrials are gradually getting back into operation again and are requiring new lamps to replace the old carbon bulbs. The railroads are also in the market for lamps. The popularity of the "golden glow" lamp for home lighting is increasing, making it evident to designers that the idea of "painting with light" is spreading.

Dry Cells.—The demand for No. 6 dry cells is steady and they are quoted at $30.55 per 100 in barrel lots.

Outlet Boxes.—In standard packages the average discount on the black boxes averages around 60 per cent off list, while the galvanized has a percentage discount of 55. The call for this material has been good because of the activity in the building industry.

Radio.—The present slump in the demand for radio equipment is producing a sobering effect upon many dealers who expected the demand would keep up. This, according to far-seeing jobbers and dealers, will result in a more stable plane of buying and demand next fall. Equipment is now available which has been on order for three months. Well-established houses are looking the ground over carefully and are laying plans for fall demands.

BOSTON

Trade is somewhat spotty this week, although the tendency is toward greater sales in most lines of ordinarily active material. A gradual return of textile operatives to work in New Hampshire and Rhode Island marks the prospective failure of the long-continued strikes in these districts. Building and engineering contracts let in New England are exceeding those of a year ago by 75 to 100 per cent, the latest week totaling about $8,000,000 and covering structures of varied sorts from mercantile to residential types. Occasional enlargements of industrial plants of smaller size and better business in many of the smaller cities of New England encourage the belief that this summer's business will be better than usual. Central-station outputs continue to reflect good gains. Prices of electrical material are fairly steady and stocks are meeting requirements in the main. Conditions in New England electrical manufacturing plants are improving on the whole, the demand for larger apparatus being a feature.

Motors.—Local sales are rather spotty, with small orders dominant. Prices are firm. Considerable manufacturing is now in progress to build up agency stocks. Jobbers are meeting the market requirements easily. Expansion of output is proceeding along conservative lines, the motor business as a whole lagging some months behind the demand for heavier equipment.

Storage Batteries.—In some quarters local stocks have been reduced by the curtailment of manufacturing during the period of depression. Jobbers report a good season in automobile battery sales, and interest in batteries for road trucks and industrial electric trucks is apparent from increased inquiries. Prices are steady on most makes, although one of the well-known manufacturers is scheduled to reduce his prices about 10 per cent July 1.

Wire.—Demand for rubber-covered wire continues more active than for weatherproof and bare copper. In 5,000-ft. lots the first-named sells at $6.25 per 1,000 ft. Weatherproof and bare bases are 17½ and 16 cents. A moderate amount of central-station buying for line extensions is evident. The demand for copper aërials has fallen off heavily.

Flexible Armored Conductor.—Competition is very sharp, and some price cutting is reported. No. 14 single-strip moves on the basis of $44.20 per 1,000 ft. in 1,000 ft. lots. Building operations continue to absorb much of this material, and some of it is in demand for wiring motor and control equipment in individual machine-tool drive betterment work.

Radio Apparatus.—The sharp drop in demand has left many dealers overstocked in spots, and jobbers are buying very little equipment of this kind at the moment. During the summer, however, it is expected that many gaps in dealers' stocks will be rounded out and prepared for a renewed active demand in the fall.

Fans.—Jobbers and dealers alike find this business very responsive to weather conditions. The recent spurt has given way to sluggish trade, pending another hot wave. Stocks are spotty.

Pole-Line Hardware.—Buying continues better, though nothing striking in orders is reported. Prices are steady. The demand is greater than was expected in many quarters at this season.

Appliances.—Sales of the lighter socket devices are picking up, and the response to lower-priced apparatus offered is encouraging. Trade is healthier also in the heavier equipment.

ATLANTA

Spot cotton in Atlanta has reached 22.25 cents per pound, and predictions are that turpentine will shortly sell for $1 per gallon. This, combined with the prospects of the biggest peach and melon crops in the state's history, is lending an excellent tone to business conditions throughout the agricultural district, and prospects are for business to be on an active and aggressive plane by early fall. The Federal Reserve ratio reached 84.3 per cent on May 29, the highest mark in the history of the Sixth Federal Reserve Bank, this being a rise of 42 per cent since early in January. Automobile dealers report a very heavy demand for the more inexpensive makes of cars, and the Atlanta branch of the Ford Motor Company has increased its daily production 50 per cent in view of the 3,500 unfilled orders which had accumulated up to June 1.

Electric jobbers report a general improvement throughout the entire line, with radio equipment and accessories playing a very prominent part in the business done. Practically all of the textile mills which have been shut down during the depression have resumed operations, the latest one to reopen being one of the Western Reserve mills in middle Georgia, while a great many of the mills are even considering double-shift operation. A general activity is to be noted among the larger central stations, and a number of large line extensions which will open up virgin territory are projected and will be under construction within the next sixty days.

Fans.—The arrival of summer in full force has brought fans into the foreground, retail dealers reporting sales as very satisfactory, and jobbers are in receipt of a reasonable volume of refill orders. Stocks are in good shape in all sizes.

Wire.—Weatherproof and rubber-covered are active, particularly in the popular sizes, with a reasonable demand for large cables and bare stranded. Inquiries for the latter type, however, by the more important central stations are for large quantities.

Bell-Ringing Transformers.—Building construction is continuing to furnish a fair demand for this specialty. Local stocks are in fair to good shape, with retail price $1.50 each.

Safety Switches.—All sizes are in brisk demand, the 30-amp. to 400-amp. types at present being the best sellers. Good stocks and shipments are reported by all jobbers, with prices steady.

Lighting Fixtures.—The movement is satisfactory in all lines of fixtures, with the commercial type particularly good. There is a marked tendency for commercial purchases to drift toward the better class of material. Stocks are in good shape with shipments satisfactory.

Distributing Transformers.—This line has not responded to the general activity and to the movement of pole-line materials, though it is expected that orders for it will improve in the next sixty days. Stocks are good to heavy throughout the section.

Vacuum Cleaners.—Except in isolated instances, this line continues very slow, little or no interest being apparent on the part of the consumer. Stocks are heavy, despite efforts to move them.

Electric Churns.—Conditions in the rural districts have not been rectified sufficiently to permit of any large volume of purchases in this line, though conditions should improve as the rural population accumulates surplus funds. Jobbers are stocked heavily and prices are steady.

ST. LOUIS

That smile of happiness that comes when business is booming was apparent in the St. Louis jobbing houses last week. It was the biggest week experienced for almost two years. Some feel that the improvement was of permanent character, and others look at it askance. At the present rate June business will be about 50 per cent better than that of May, which was in itself a comparatively very good month. One of the principal features was the heavy demand for fans, hot weather having given the necessary stimulus. Residential construction is growing rapidly, and many of the houses are reaching the wiring stage.

Fundamentally general business is much improved, the industrials again being active, and the morale of the buying public is stronger than it has been since the beginning of the recent business depression. The wheat outlook remains good, and in some sections the crop is virtually made. The corn crop is generally good, though some portions of Iowa report insufficient rain. Cotton has been materially helped by the recent dry weather, and the government reports show splendid conditions in northern and northeastern Arkansas.

Missouri reports show oats to be slightly off. The farmers on the whole are much encouraged over the prospects for this year.

St. Louis is planning extensive municipal improvements, and a bond issue will probably be voted on to supply funds for about $75,000,000 of work. This will provide for new hospitals and institutions, sewer reconstruction, playgrounds, major street widening, grade crossings, a new civics building, additional fire department equipment, sites and buildings as memorials, additional waterworks, and a municipal heat, light and mechanical building. The amount allotted for the additional water works is $12,000,000, and for the heat, light and mechanical building $1,000,000 is provided.

Fans.—The first hot weather of the season came this week, and a dull fan market has suddenly become extremely active. Dealers' stocks have moved with exceptional rapidity, and jobbers have consequently been able substantially to lower their stocks, which were becoming heavy. Local dealers report that the 12-in. six-blade oscillator is the best seller this season. Ceiling-type fans are moving comparatively well, and an improved call for exhaust fans is also reported.

Battery-Charging Sets.—A gratifying improvement in demand for electric trucks and battery-charging sets is found. In preparation for business when the strike is terminated the coal-mining companies are making inquiries and purchases of charging sets for the operation of mine locomotives. Delivery in about thirty days can be given.

Porcelain.—The demand continues steady and stocks remain conservative. Larger individual orders are being placed, as is indicated by one comparatively small contractor buying ten barrels last week. The following prices are representative: "Nail-it" knobs, $16.50 per 1,000 in barrel lots and $15 per 1,000 for one to five barrels; split knobs, $12 per 1,000 in barrel lots; ⅝-in. x 2½-in. tubes, $5.40 per 1,000 in barrel lots and $3.73 per 1,000 in larger orders.

SAN FRANCISCO

Building is still increasing, the larger number of permits indicating a disproportionate amount of residence construction. Retail store business was dislocated not only in San Francisco but in all the surrounding country by the Mystic Shrine convention, culminating in a final display that was witnessed by nearly a million people.

Schedule Material.—Nearly all shipping in this line is by way of steamship, averaging about forty days, compared with twenty days by rail. Several schedule manufacturers maintaining local offices have changed over from rail to boat on account of competition. The steamship carload rates are about $2.25 per 100 lb., and the rail rate is about $3.50 per 100 lb. In some instances this change of route produced stock shortages, but these gaps are now filled up so that excellent stocks are on hand and the demand is very good although rather scattered.

The low package price on fuse plugs has produced a shortage, nearly all dealers loading up in expectation of a raise. Dealers are getting only a small proportion of business from residence construction in the outlying city districts. It is evident that still greater publicity of the socket convenience outlet idea is needed. Such houses are nearly all built ready made by tract owners, and only a wider public knowledge and demand can correct the skimping of electrical fittings. Some excellent corrective measures are now being worked out by the California Electrical Co-Operative Campaign.

Poles.—Sales have been excellent this spring and excess stocks have become subnormal. There is only a limited stock of seasoned poles, but there is a big demand for them because of the ease of handling and freighting. Treated poles are being increasingly specified. Big consumers are being warned to prepare for the railroad strike that is threatened for July first.

Appliances.—Washer sales are greatly improved. Vacuum cleaner sales are decreasing in volume though better distributed among all the dealers. Ironer sales are quiet, but the volume of electrically heated ironers has greatly increased. Dishwashers and sewing machines are moving rather slowly. Excellent publicity was secured for "June bride" week despite the counter publicity of Shrine week, which immediately followed it. No reliable data of actual and comparative sales will be available until the end of June, but all dealers co-operated loyally and most of them believe that the idea was successfully put across.

Rubber-Covered Wire.—No. 14 single-braid, solid, in 5,000-ft. lots, has now advanced to $6.75 per 1,000 ft., with a 10 per cent advance in coil lots. No. 14 duplex solid is being quoted for about $17.75 per 1,000 ft. in 5,000-ft. quantities. These prices may be considered a good indication of the market.

PORTLAND—SEATTLE

Non-employment showed a marked decrease in Oregon and Washington during the month of May, increased building activity and road construction having absorbed virtually all surplus labor. Alaska is coming back strong, cargo movements from Seattle to Alaska for the first five months of the year showing a gain of 126 per cent as compared with the corresponding period of a year ago. Tourist travel to Alaska is also heavier. The lumber business continues to book new business in excess of production. Production for the week ended June 10 was 9 per cent above normal. Increases in wages are reported from various quarters in the lumber industry.

In the electrical field extensions to distribution lines are being made more generally than a year ago. Power companies are apparently realizing that the bottom of the market in many materials has about been reached and are buying more freely. A 25 per cent reduction in the charge for off-peak power recently put into effect by the city of Seattle lighting plant is stimulating the use of power in considerable blocks in a number of industries. Contracts for energy to supply electric furnaces as well as forty bake ovens have recently been signed, it is reported.

Jobbers report business improving and are well pleased with the continued increase. Estimates of increased business vary, it being said to be from 10 to 25 per cent better than a year ago. Quotations are very active for new construction work. Demands are reported good on wire, conduit and wiring supplies for out-of-town shipments. Collections are improving slightly in the Portland district. The average date of outstanding bills for May was a little over forty days as against a little over forty days for April. Jobbers are still watching credits very closely because of the very narrow margin at which contracting work is being taken. Stocks are in good shape, most of them for the past year coming by water. Freight-rate reductions effective July 1 will probably not alter this situation. Shipments come through in an average of about four weeks from Eastern factories.

Porcelain.—Knobs and tubes are in very good demand owing to extensive building. Prices, which have been near the bottom for months, remain unchanged. Stocks are ample to meet the demand. Insulators are moving better as a result of extensions and some new construction now going on. Prices likewise are well down and have remained unchanged for some months.

SALT LAKE CITY—DENVER

Collections are reported better than they have been in months. Easier credit and a better movement of stocks are given as chief reasons for the improvement. Banks are in a much better position to extend credit where good security is offered. The investment market shows an active tendency, stocks and bonds with a good rate of interest being eagerly sought by large and small investors. In the electrical field retail dealers are stocking much better than formerly, some buying in volumes that suggest the return of the old-time stability of the market. Jobbers' stocks in practically all lines are more than ample, no recent shortages having developed.

Hollow ware is moving in better shape, after a long period of being consigned to the "luxury" list. Percolators have been in special favor as gifts to June brides. Flatirons also have sold pretty well.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

San Francisco Radio Concern Expands

W. A. Layman, president of the Wagner Electric Manufacturing Company of St. Louis, and C. B. Kennedy, president of the Colin B. Kennedy Company of San Francisco, announce that the two companies have joined in an arrangement to increase the facilities of the Kennedy company in serving the radio field.

Both companies involved in the transaction are recognized as leaders in their respective fields. Mr. Layman states that the joint plan was possible largely because both organizations have built their reputations on the quality ideal.

The engineering personnel includes radio men of national reputation and is of such character as will insure the company keeping abreast of progress in the radio art. The engineering department is under the direction of Dr. Leonard F. Fuller, who is largely responsible for the development of the Poulsen arc transmitter as now used for world-wide communication in practically all the high power stations in the United States Navy.

The Kennedy company will continue to operate at full capacity the manufacturing plant established at San Francisco, the output of which will be used to meet the requirements of the Western trade and supplement production at St. Louis.

Oregon Holds Third Electrical Home Exhibit

The third electrical home exhibition to be held in Oregon was given in Silverton on May 4, 5 and 6. During the three-day exhibit 589 adult persons signed the register, which is more than 20 per cent of the population of the town of Silverton. The affair as a whole was a credit to the electrical industry and much lasting good is expected to result.

Rome Wire Company Takes Over Toledo Concern

The Rome Wire Company has purchased all equipment of the Toledo Enameled Wire Products Company of Toledo, Ohio, and intends to install this equipment in its main plant at Rome, N. Y., as soon as possible.

The Toledo Enameled Wire Products Company during its period of operation earned a high reputation for the quality of its product, which consisted mostly of large and intermediate sizes of enameled and cotton-covered wire. The purchase of this equipment by the Rome Wire Company will considerably increase the latter's production.

The company reports that the volume of magnet wire business has materially increased and that prices are firmer than they were a few weeks ago.

Bakelite Corporation Merger Details Announced

That the Bakelite Corporation has taken over the General Bakelite Company, the Condensite Company of America and the Redmanol Chemical Products Company is announced by officials of the first-named concern.

The merger is the result of a suit for infringement of the Bakelite patents brought against one of the customers of the Redmanol Company, the General Insulate Company of Brooklyn. This suit resulted in an unqualified victory for the Bakelite company and the entry of a decree in the United States District Court for the Eastern District of New York on May 11.

The Bakelite patents which are thus broadly sustained cover the molding in general of phenolic condensation products by heat and pressure and the use in such products of fibrous bodies such as wood flour, asbestos, etc. In a previous suit against George J. Nicholas & Company the Bakelite patents covering the manufacture of varnishes and solutions had been broadly sustained.

The decision against the General Insulate Company and the bringing of other suits against Redmanol customers made it impracticable for the Redmanol Company to continue its business, and in order that the value of the good will, plant, and organization might not be lost, it was decided to consolidate its business, including the personnel, with that of the General Bakelite Company.

The Redmanol Company in the meantime having purchased a controlling interest in the Condensite Company, the inclusion of that company in the merger was made possible. The Condensite Company had been operating under the Bakelite patents for several years, paying royalties as the result of suit against it in 1913.

Dr. L. H. Baekeland is the president of the new Bakelite Corporation, with Philip Schleussner, A. Karpen and Kirk Brown vice-presidents.

Dr. Baekeland remains also president of the General Bakelite Company, Kirk Brown president of the Condensite Company of America, and Dr. L. V. Redman president of the Redmanol Chemical Products Company.

Dubilier Condenser & Radio Corporation Plans Expansion

Announcement has been made that the Dubilier Condenser & Radio Corporation, which markets the "Ducon," has been receiving orders at the rate of 150,000 a month and that the company plans immediate expansion to bring production up to the rate of 5,000 daily.

The "Ducon" is a small instrument to be attached to an ordinary electric light socket, obviating the necessity of aërial installation. A great many wireless enthusiasts, particularly those who live in apartments and others living in houses but subject to the restraint of landlords, have found the installation of aërials an impediment to their individual ownership and use of the wireless. For such, the "Ducon," says the manufacturer, opens wide the door, for by attaching it to an ordinary electric light socket enthusiasts may now get better results than would be possible with an aërial constructed by individual enterprise.

Dingle-Clark Company Opens Cincinnati Office

The Dingle-Clark Company, contracting engineers, Cleveland, Ohio, specializing in the sale of power-plant equipment, announces the opening of a Cincinnati office at 605 Mercantile Library Building, in charge of C. G. Tarkington. On completion of his electrical engineering course at Purdue University, Mr. Tarkington spent some time in the testing department of the General Electric Company and after some operating experience was associated with the Cutler-Hammer Company of Milwaukee and Kohler Brothers of Chicago as a designing engineer. For the last eleven years he has been sales engineer with the Westinghouse Electric & Manufacturing Company and the Mechanical Appliance Company.

Creosoted Fir Poles Excel in Southern France

Creosoted poles have been found, after protracted experimentation, to be the best for carrying electric power wires in southern France. Investigations carried on by the leading electric companies have determined that, as regards both longer life and conductibility, the creosoted fir poles excel. In the course of experiments at Marseilles it was found, according to Consul Wesley Frost, that iron poles, in spite of any system of repairing, are subject to destruction by oxidation, while reinforced-concrete poles are difficult to manufacture locally or to transport if manufactured at central points. Furthermore, the average life of reinforced-concrete poles is uncertain, says the report.

From the standpoint of long life, it has been found that creosoted fir poles are most economical. These last from twelve to fourteen years, creosoted pine coming second with a life of nine to ten years.

Westinghouse Makes Record Equipment Shipment

Largest Single Consignment of Apparatus for Chilean Railroads Called Important Event in History of Electrical Industry

An important event in the history of the electrical industry was marked when the largest single consignment of electrical apparatus for railroad electrification ever made was shipped recently from the works of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

This shipment represented the first consignment of electrical equipment for the electrification of the Chilean State Railways. The contract for the initial installation amounting to $7,000,000, which was considered by industrial leaders as one of the first indications of a business revival, was awarded by the South American Republic to the Westinghouse Electric International Company last October after the severest competition from manufacturing concerns in the United States and other countries.

This train load of apparatus, shown in the picture, consisted of thirty-two cars and was about 1,300 feet, or almost a quarter of a mile, long. It was one of the longest trains that ever left the Westinghouse plant with a consignment of material covered by one contract. The shipment included two complete substation equipments for supplying power at 3,000 volts direct current to the Chilean State Railways, which is now being electrified. Each substation includes motor-generator sets, transformers and switching equipment. The remaining substation equipment will be shipped from the Westinghouse plant to the Republic of Chile within the next thirty days, and the shipment of the locomotives for the electrification, thirty-nine of which are included in the order, will, according to the officials of the Westinghouse Company, commence in July.

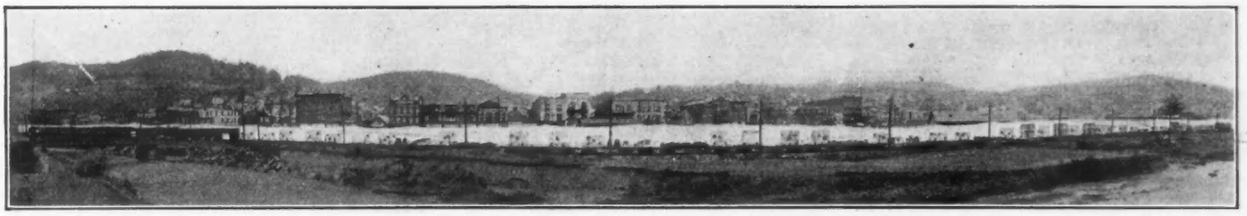
The awarding of the contract to the Westinghouse Company assured the electrification of the Chilean State Railways in accordance with the American standards and constituted a tribute to American leadership in the electrical industry, as this electrification is by far the most important one undertaken in 1921 and 1922 and is the largest and most comprehensive single order for electrification equipment ever received in the United States.

The initial electrification of the Chilean State Railways will include 144 miles, 116 miles from Valparaiso to Santiago and 28 miles from Las Vegas to Los Andes. The maximum grade in this zone, 2¼ per cent, was encountered in approaching La Cumbre from the west. The main line of this railroad has six tunnels, the longest being 1,600 ft. in length.

The waters of the Rio Colorado will be utilized in the generation of the power to be furnished the railroad. The station which will generate this power for the electrification will have three 8,125 kva. Westinghouse generators. The 110,000-volt power will be transmitted 37 miles to Santiago, where it will be connected with the system fed by the Florida hydro-electric station and the Mapocho steam station, both of which have been operating for some years.

The construction of the electrical equipment has been under the direction of the officials of the power and railway departments of the Westinghouse company and representatives of the Chilean State Railway who are in this country. The latter include Carlos Schneider, managing director for activities in the United States of the Chilean State Railways; Enrique Palma, Domingo Santa Maria and A. Gomes.

The Westinghouse company is building in its shops at East Pittsburgh at this time locomotives or motor equipments for shipment to Japan, England, Colombia, Manchuria and other countries. It also has on order a large amount of power equipment for nearly all of the foreign countries, this consisting of turbines, rotary converters, transformers, switching equipment, etc.



WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S RECORD SHIPMENT OF ELECTRICAL APPARATUS, FILLING THIRTY-TWO CARS, LEAVING THE EAST PITTSBURGH PLANT FOR SOUTH AMERICA

Chicago Distributor Obtains Better Quarters

The James E. Gleason Company is now located at 650-652 West Monroe Street, Chicago. The Burlington fire on March 15 destroyed its old quarters at 515 West Jackson Boulevard. For a short time the company had its headquarters at 9 South Clinton Street, but since April 15 it has been at the new location.

According to Mr. Gleason an increase of about 25 per cent in floor space was obtained by this change-over. He stated that he had transacted about ten times as much business since the fire as he had done during the same period last year. He also reported that the building industry was as active outside of Chicago as it was in the city. This company acts as distributor for manufacturers of conduit fittings, armored cable and porcelain.

The Nunn Electric Company of Amarillo, Tex., has been organized to conduct a retail business in electrical fixtures and goods, with stores in Amarillo, Dallas and several other Texas cities as well as several stores in Oklahoma and New Mexico. The company is capitalized at $30,000, and the incorporators are: J. L. Nunn, F. B. Spencer and P. R. Underwood.

The Electric Maid Shop of Portland, Ore., has moved to new and more spacious quarters on Alder Street between Fourth and Fifth Streets. This shop specializes in household conveniences and appliances.

The Connecticut Instrument Company, Stamford, Conn., recently organized to succeed the Allen-Hogan Company, Brooklyn, N. Y., has leased the former local plant of the Lounsbury-Soule Company and will establish a factory for the manufacture of radio equipment and devices. The equipment from the Brooklyn works will be removed to this location and other machinery acquired for installation. It is planned to inaugurate production at an early date. The company is capitalized at $100,000. R. E. Gillmore, formerly general manager Sperry Gyroscope Company, Brooklyn, is president.

The Acme Wire Company, Hamden, Conn., will develop an increased line of production at its plant, to include static electric condensers of special type and other electrical equipment.

The Shaw Insulator Company, Newark, N. J., has recently purchased a two-story concrete and steel-reinforced building, 50 ft. x 100 ft., together with a two-story building, 30 ft. x 50 ft., which will be used for power-house purposes.

The Western Electric Company's Portland (Ore.) branch will have a new home upon completion of a three-story brick building to be erected immediately for its exclusive use at the corner of Park and Flanders Streets. It will cost $35,000 and be ready for occupancy the latter part of August.

The Formica Manufacturing Company, Cincinnati, is enlarging its factory space, adding about 120,000 sq.ft., and will increase production approximately 100 per cent, officials of that company have announced.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An inquiry has been received from Norway (No. 2,460) for the purchase of heater bricks, made of porcelain or clay, to be used as heating elements for electric hot plates, the annual purchase to be 8,000 to 10,000 bricks.

A merchant in India (No. 2,538) desires to purchase and secure an agency for electric goods and accessories, such as electric fans, lamps, and electric engine accessories for crude-oil engine and sewing machines.

EQUIPMENT FOR MORWELL (AUSTRALIA) POWER SCHEME.—Tenders will be received by the State Electricity Commission of Victoria, 673 Bourke Street, Melbourne, Australia, until Sept. 1, the *Electrical Times* states, for furnishing the following equipment: Specification 226, item 1—five surface-feed water heaters, two of 2,250 sq.ft. surface, three of 1,450 sq.ft. surface; item 2—six surface vapor condensers, each 105 sq.ft. surface; Specification No. 227, item 1—twelve feed-water evaporators, to operate in groups and multiple effect, four effects producing 12,500 lb. per hour. R. Liddlelow, secretary of the commission.

Foreign Trade Notes

GREAT INCREASE IN USE OF WATER AND LIGNITE FOR POWER PURPOSES IN GERMANY.—The use of water and lignite for power requirements in Germany, according to the *Electrician*, has greatly increased in the last few years. In 1913 about 75 per cent of the whole of the electricity supply was produced by ordinary coal, water power and brown coal (lignite) accounting for about 15 per cent of the remainder. Only about 50 per cent of black coal, it is stated, is now used, the proportion of lignite having increased to nearly 35 per cent. In eight or ten years it is estimated that by an extension of existing hydro-electric plants, together with new water-power developments, it will be possible to generate by water power alone 50 per cent of all the power required for industrial and private uses and for traction. In Bavaria and the South German states hydo-electric developments will permit the discontinuance almost entirely of the use of ordinary coal for industrial work, and make possible the electrification of all the railways in south Germany.

ELECTRIC PLANT FOR MACEDONIA, GREECE.—By direction of the Greek Minister of Public Works, according to *Commerce Reports*, a committee has been appointed to make investigations regarding the plan for the construction of an electric plant at Vodena, Macedonia, using the falls of the Voda River, which it is estimated will develop about 20,000 hp. The cost is estimated at 20,000,000 drachmas ($900,000).

LARGE POWER PROJECT FOR HOLLAND.—A commission, according to the *Electrician*, has been appointed by the Holland government to look into a project for erecting five large power stations, which are to be connected by a 50,000-volt cable. One station is to be in Amsterdam, one in Rotterdam, one in Dutch Brabant and another in the Dutch coal-mine district. The location of the fifth power house has not yet been decided upon.

ELECTRIFICATION OF RAILROADS IN HOLLAND.—In connection with a scheme for erecting power stations in various cities in Holland, according to the *Electrical Review*, it is proposed to equip the Izeren Spoorweg Maatschappij railway for electrical operation, plans having been drawn up in 1918. Next in order are the secondary lines which, with the state railways, are now being surveyed. Overhead transmission, it is said, will be preferred, owing to the characteristics of the ground. The power station, which will have a capacity of 30,000 kw., will be at Leidchen Dam, to the east of The Hague. The existing steam tramway lines are also to be electrified. The concession for the conversion of the Gooische tramway will, it is expected, be granted this year. The conversion of the line has been completed and work has been started on the construction of the power station. The Zeeuwsch Vlaamsche Tramweg Maatschappiji of Axel, Zeeland, it is said, proposes to establish in this province a new line of tramways with stations, depots, etc., the work to be started this year.

PROPOSED EXTENSIONS TO THE TELEPHONE AND ELECTRIC SYSTEMS IN ROTTERDAM.—Proposals have been submitted to the Town Council of Rotterdam, Holland, according to the *Electrician*, for an extension to the telephone exchange building, to have a capacity of 20,000 telephones, to cost about 450,000 guilders. It is also proposed to erect an additional power station, which will probably be equipped with three generating units of 1,500 kw. each, to cost approximately 600,000 guilders.

PROPOSED STREET-CAR SYSTEM FOR VALDIVIA, CHILE.—Permission has been granted by the city government of Valdivia, Chile, *Commerce Reports* states, to a Chilean engineer to establish a street-car system in that city. The part of the petition requesting a grant of certain waterfalls and of city property as a site for the power house was denied. The plans provide for a number of lines, including one from the market to the railroad station. The name of the engineer holding the above concession may be obtained from the Latin-American Division by referring to "Street Car System at Valdivia," No. 53,448.

New Apparatus and Publications

RADIO MOTOR-GENERATOR SET.—The Emerson Electric Manufacturing Company, St. Louis, is distributing bulletin No. 3,603, covering its new motor-generator set, designed especially for radio service.

POLE TREATMENT.—The Naugle Pole & Tie Company, 5 South Wabash Avenue, Chicago, has issued a catalog describing the butt treatment of cedar poles.

STATIC CONDENSERS.—The National Electric Condenser Company, New Haven, Conn., is distributing bulletin No 1, describing and illustrating its static condensers for the correction of low power factor.

ALTERNATING-CURRENT GENERATORS.—Bulletin No. 1,099-B issued by the Allis-Chalmers Manufacturing Company, Milwaukee, covers its alternating-current generators for belt drive and also for direct coupling.

BATTERY CHARGES.—The Valley Electric Company, 3,157 South Kingshighway, St. Louis, has developed two new types of battery chargers, known as "Valley" type "W" for the radio battery and "Valley" type "MC" for automobiles. Both have been approved by the National Board of Fire Underwriters.

VALVES.—The English Electric Company, Ltd., Queens House, Kingsway, London, W. C. 2, is distributing publication Nos. 330 and 331, describing its cylindrical balanced valve and relief valve respectively. Publication No. 332 issued by the company covers its bucket attachment for impulse wheels.

OIL ENGINE.—"The Fullagar Oil Engine for Land Purposes" is the title of publication No. 366 issued by the English Electric Company, Queen's House, Kingsway, London, W. C. 2, in which it describes the Fullagar oil engine.

DISTRIBUTION TRANSFORMERS.—The Allis-Chalmers Company, Milwaukee, is distributing bulletin No. 1,109, covering its various types of distribution transformers.

BATTERY CHARGING OUTFIT.—The Hobart Brothers Company, Troy, Ohio, is distributing a leaflet covering its new "HB" constant-potential charging outfit for battery stations.

NEW ATTACHMENTS FOR SUCTION CLEANER.—The Hoover Suction Sweeper Company, Canton, Ohio, has developed several improved and simplified new attachments designed for used with Hoover suction sweeper.

THEATER DIMMERS.—The Ward Leonard Electric Company, Mount Vernon, N. Y., is distributing an eight-page pamphlet covering its "Vitrohm" (vitreous enameled) theater dimmers.

FUEL ECONOMY.—"Keeping Down Furnaces Losses" is the title of the leading article in the May edition of "Power Notes," published by the Diamond Power Specialty Corporation, Detroit.

FLEXIBLE GRINDER.—A new "Stow" radial flexible grinder has recently been developed by the Stow Manufacturing Company, Binghamton, N. Y.

ELECTRIC COFFEE URN HEATER.—An electric coffee urn heater designed for use in hotels, restaurants, etc., has been brought out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

ELECTRIC METERS AND INDICATORS.—Bulletin No. 820, issued by the Roller-Smith Company, 233 Broadway, New York City, describes its "PV" ammeters and voltmeters and "COD" indicators.

CIRCUIT BREAKERS.—The Roller-Smith Company, 233 Broadway, New York City, is distributing Bulletin No. 560, covering its types "E" and "P" inclosed circuit breakers.

MERCURY-ARC LAMP.—Engineering Department bulletin No. 104, issued by the Cooper Hewitt Electric Company, Hoboken, N. J., describes its "Lab-Arc" monochromatic light. This is a quartz mercury-arc lamp designed specifically to combine all the advantages of these lamps with special provisions for laboratory use.

New Companies

THE FRIENDSHIP (TENN.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $3,000 by J. T. Carman, W. C. James, L. L. Dunagan, C. E. Sweatt and William H. Stallings.

MURTAUGH (IDAHO) LIGHT & POWER COMPANY has been incorporated by Harvey and M. S. Ball and Harry Winterburn. The company is capitalized at $15,000.

THE MIDLAND ELECTRIC MANUFACTURING COMPANY, 4,224 West Harrison Street, Chicago, has been incorporated with a capital stock of $50,000 by Elmer R. Talbot, Leo E. Dolan and James F. Cramek. The company proposes to manufacture and also to deal in electrical equipment and specialties.

THE STATES RADIO CORPORATION, 501 South Jefferson Street, Chicago, has been incorporated by George Carlson, Anstol Golles, Thomas J. Hickey and others. The company is capitalized at $100,000 and proposes to manufacture and deal in radio apparatus and equipment.

Record of Electrical Patents

Notes on United States Patents

(Issued May 30, 1922)

1,417,806. METHOD AND APPARATUS FOR FORMING HEADED ARTICLES; O. H. de Lapotterie, Kent, Ohio. App. filed March 1, 1918. Machine for heating and upsetting nails, rivets, etc.

1,417,896. ELECTRODEPOSITION OF METALS UPON IRON AND ALLOYS OF IRON; R. J. Fletcher, London, England. App. filed Jan. 17, 1921. Iron electrolytically cleansed before deposition.

1,417,912. VACUUM ELECTRIC APPARATUS; P. C. Hewitt, Ringwood Manor, N. J. App. filed June 24, 1916. Voice transmitter connected directly to vacuum tube.

1,417,913. APPARATUS FOR GENERATING HIGH-FREQUENCY ELECTRIC CURRENTS; Alexander Heyland, Brussels, Belgium. App. filed July 28, 1914. Frequency controlled by oscillations of field circuit.

1,417,945. TROLLEY-POLE HEAD; Vincenzo Saccone, Johntown, Pa. App. filed Jan. 10, 1922. Guard prevents disengagement of wire.

1,417,953. ELECTRIC FURNACE; Filip Tharaldsen, Trondhjem, Norway. App. filed March 1, 1915. Zinc produced by condensing vapor.

1,417,957. ELECTRIC SWITCH; Max Vogelsang, Frankfort-on-the-Main, Germany. App. filed June 5, 1915. Time lag relay operated by voltage drop.

1,418,000. TELEGRAPH APPARATUS; Edward L. Klingel, St. Paul, Minn. App. filed Feb. 6, 1918. Open-circuit telegraph circuit.

1,418,007. MOTIVE-POWER APPLIANCE FOR SEWING MACHINES AND THE LIKE; David Lustig, Paris, France. App. filed June 29, 1920. Small motor attachment.

1,418,011. ELECTRICAL WATER HEATER; Hermann Mehn, Berlin-Tempelhof, Germany. App. filed Oct. 12, 1921. Water-tubes surrounded by the element.

1,418,022. DISCHARGE-TUBE RELAY FOR UNDULATORY CURRENTS; Eugen Reisz, Treptow, Germany. App. filed June 5, 1915. For reinforcing weak current undulations.

1,418,023. APPARATUS FOR CONVERTING DIRECT CURRENTS OF LOW VOLTAGE INTO DIRECT CURRENTS OF HIGH VOLTAGE; Eugen Reisz, Treptow, Germany. App. filed June 25, 1915. By self-induction coil and condensers.

1,418,030. ELECTRICALLY HEATED FURNACE; C. W. Speirs, London, England. App. filed March 9, 1920. Resistance type for melting metals.

1,418,051. LIGHTING SYSTEM FOR AUTOMOBILES; Edwin C. Ballman, St. Louis, Mo. App. filed Sept. 13, 1915. Lights from magneto automatically controlled.

1,418,066. RADIO-TRANSMITTING SYSTEM; T. R. Bunting, Norfolk, Va. App. filed June 2, 1920. Two messages transmitted simultaneously.

1,418,132. WRITING-LIGHTING DEVICES; J. J. Devine, Middletown, Conn. App. filed April 24, 1920. Pen and pencil combined in tube with electric light.

1,418,139. APPLIANCE FOR REGULATING THE HARDNESS OF ROENTGEN-RAY TUBES; H. F. Eiken, Skorping, Denmark. App. filed Jan. 15, 1920. Means for regulating vacuum.

1,418,171. PLUG AND SOCKET CONTACT; Bruno Raettig, Colongne-Lindenthal, Germany. App. filed Sept. 17, 1921. For power circuits.

1,418,183. GRAPHIC RECORDER; Charles B. Thwing, Philadelphia, Pa. App. filed March 11, 1921. Inking device.

1,418,187. AUTOMATIC TELEPHONE SYSTEM; D. S. Hulfish, Toronto, Ont., Can. App. filed May 27, 1918. Automatic switch having busy-testing and speaking positions.

(Issued June 6, 1922)

15,370 (reissue). VOLT-AMPERE METER; Donald J. Angus, Indianapolis, Ind. App. filed Nov. 12, 1921. Measures volts times amperes regardless of power factor.

15,378 (reissue). ELECTRIC FURNACE; H. G. Weidenthal, Cleveland, Ohio. App. filed March 25, 1920. Adapted to brass, bronze and aluminum founders.

1,418,285. TRANSLATING CIRCUIT; J. R. Carson, New York, N. Y. App. filed Oct. 10, 1918. Carrier-current elephone system.

1,418,302. LIGHTING FIXTURE; E. F. Guth, St. Louis, Mo. App. filed April 25, 1919. Maintains proper light center with different lamps.

1,418,322. ELECTRIC SIGNAL APPARATUS FOR ELEVATORS; R. A. Newe, Houston, Tex. App. filed Jan. 12, 1920. Combination of outside and car indicator.

1,418,362. ELECTRICAL RESISTANCE; W. W. Coblentz, Washington, D. C. App. filed Sept. 22, 1920. Resistance sensitive to certain light waves.

1,418,367. ELECTRICAL MEASURING INSTRUMENT; H. L. Decker, Toledo, Ohio. App. filed Jan. 14, 1919. Magnet vane-type ammeter.

1,418,369. METHOD OF FILLING THE INSULATION OF HOLLOW CABLES AND PRODUCT THEREOF; H. W. Fisher and R. W. Atkinson, Perth Amboy, N. J. App. filed Aug. 28, 1920. High-voltage cables.

1,418,370. CONDUIT FASTENER; J. M. FitzGerald, Chicago, Ill. App. filed Aug. 15, 1917. Fastener for conduit caps.

1,418,390. DYNAMO-ELECTRIC MACHINE; A. H. Neuland, Glensdale, Cal. App. filed Jan. 23, 1918. Magnetic gear for ship propulsion.

1,418,398. RECTIFIER SYSTEM; A. C. Reid, Genoa, Ill. App. filed June 24, 1920. For charging storage batteries.

1,418,449. ELECTRIC STARTER FOR AUTOMOBILE ENGINES; H. L. Meeder, Denver, Col. App. filed April 12, 1919.

1,418,460. HEAT-STORING AND WATER-EVAPORATING PLANT; H. Pfenninger, Wadenswil, Switzerland. App. filed March 21, 1919. By electricity.

1,418,468. ELECTRICAL CONNECTOR; John Raus, Cleveland, Ohio. App. filed Aug. 27, 1919. For connecting small wires.

1,418,477. TRANSFORMATION OF DIRECT CURRENT; M. Schenkel, Charlottenburg, Germany. App. filed March 29, 1917. Direct current changed to polyphase by rectifiers.

1,418,487. KEYLESS CLOCK; A. L. Sohm, Chicago, Ill. App. filed Sept. 18, 1919. Electrically wound.

1,418,496. ELECTRIC HEATER; F. G. Van Dyke, Detroit, Mich. App. filed Nov. 15, 1920. For attaching to cups, bowls, etc.

1,418,518. QUENCH ROTARY SPARK GAP; E. F. Bell, Indianapolis, Ind. App. filed Sept. 20, 1920. Gap inclosed by airtight casing.

1,418,633. HEATING-BAR TERMINAL; G. Egly, Berlin-Treptow, Germany. App. filed Oct. 21, 1920. Means for attaching conductors to heating bars.

1,418,650. PIPE CLAMP; F. I. Johnson, Warren, R. I. App. filed July 3, 1920. For grounding conduits.

1,418,667. COMBINATION ELECTRIC AND GAS HEATER; Carrie A. Muir, Los Angeles, Cal. App. filed Jan. 30, 1922. For household use.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

MANCHESTER, N. H.—The Manchester Traction, Light & Power Company has issued $2,059,000 in bonds, part of the proceeds to be used for extensions and improvements.

NEW IPSWICH, N. H.—The installation of a municipal electric light plant in New Ipswich is under consideration.

BRANDON, VT. — The Public Service Commission has granted the Hortonia Power Company permission to increase its capital stock from $500,000 to $1,000,000.

BOSTON, MASS.—The Boston Elevated Railway Company has taken out a permit for the erection of a new generating plant at the rear of 696 East First Street, to cost about $350,000.

LEXINGTON, MASS.—The citizens have voted to install electric lamps on Albemarle, Arcadia and Ridge Avenues, and also on Webb Street.

THOMPSONVILLE, CONN.—At a special town meeting held recently the proposal to install an ornamental lighting system was carried. The cost is estimated at about $15,000.

WALLINGFORD, CONN.—The committee appointed to investigate the electric lighting situation has decided to recommend to the Board of Electric Light Commissioners that steps be taken to purchase power for distribution by the municipal electric plant. The cost is estimated at about $30,000.

WESTPORT, CONN. — The Westport Water Company will erect a transmission line to Lyons Plains and Upper Weston, a distance of 2 miles.

Middle Atlantic States

AMSTERDAM, N. Y.—Arrangements are being made by the Adirondack Power & Light Company to erect a large switching station at the Inghams Mills power station.

AMSTERDAM, N. Y.—The Adirondack Power & Light Company has applied to the Public Service Commission for permission to operate in the village of Munnsville and in the town of Stockbridge, and for approval of franchise granted the company by these municipalities.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company contemplates improvements to its system, including the installation of a 600-hp. boiler and switchboard at the Willow Point plant and a new switchboard at Noyes Island.

BROOKLYN, N. Y.—The Brooklyn Edison Company has acquired a site, bounded by Third and Fourth Streets and Fourth and Fifth Avenues, for a new generating plant.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, board of education of school district of city of New York, Flatbush Avenue Extension and Concord Street, Brooklyn, until June 26 for installing electric wiring and fittings in new Public School 67; for installing gas and electric fixtures in new Public School 54, both in Brooklyn; for installing electric equipment in new Public School 54 on Hillside Avenue and 127th Street, Richmond Hill, and for installing electric equipment in new Public School 102 on Van Horn Street, borough of Queens. Plans and specifications may be obtained at the Brooklyn branch of board of education, 131 Livingston Street, and at branch office 69 Broadway, Flushing.

BUFFALO, N. Y.—The Inland Lakes & River Transit Company contemplates building several electric, steel and self-propelling barges for operation on the barge canal between Buffalo and New York City, to cost $150,000 each. C. A. Swigent, Marine Trust Building, is manager.

BUFFALO, N. Y.—The Buffalo General Electric Company has awarded contracts to Huntley & Derdenger, Electric Building, for the erection of a substation at Main and Hertel Streets and for an outdoor switching station, 200 ft. x 400 ft., at its Tonawanda power plant.

LA SALLE, N. Y.—The Walmore Electric Light Company, Sanborn, has applied to the Niagara Town Board for a franchise to furnish electricity in the township.

NEW YORK, N. Y.—The New York Edison Company has awarded a contract to the Louis Weber Building Company, 342 Madison Avenue, for the erection of an addition to its substation at 100 Water Street.

OLEAN, N. Y.—The Niagara, Lockport & Ontario Power Company, Buffalo, has received permission from the Public Service Commission to purchase the property of the Olean Electric Light & Power Company. A transmission line will be erected from a point near Buffalo to Olean, to cost about $600,000.

POTSDAM, N. Y. — The St. Lawrence Transmission Company will erect a transmission line from the power plant at Hannawa Falls to Parishville to furnish electricity in that village.

WATKINS, N. Y.—Steps have been taken by the Commissioners of Watkins Glen for the installation of an electric lighting system in the Glen.

CAPE MAY, N. J.—The plant and holdings of the Stone Harbor (N. J.) Electric Light & Power Company will be offered for sale on July 7 by Edgar W. Hunt, special master in bankruptcy.

CHAMBERSBURG, PA. — The Council has awarded a contract to Quigley Hofer, Chambersburg, for the erection of a municipal power plant to cost $123,000. A. C. Wood, Stock Exchange Building, Philadelphia, is engineer.

McKEE'S ROCKS, PA. — A one-story power house will be erected in connection with the new local vaseline plant of the Chesbrough Manufacturing Company, 17 State Street, New York City, to cost about $500,000. The Hunting-Davis Company, Century Building, Pittsburgh, is architect.

NORRISTOWN, PA. — The Worcester Electric Transmission Company and the Lower Providence Electric Transmission Company, recently organized, are planning to erect and operate electric transmission systems in Montgomery County.

PHILADELPHIA, PA.—The R. B. Dutt Company, 1726 Mascher Street, will build a one-story power house at its dye works.

PHILADELPHIA, PA. — The Philadelphia Suburban Gas & Electric Company has issued $700,000 in bonds, part of the proceeds to be used for extensions and improvements.

PHILADELPHIA, PA.—The Philadelphia Electric Company has awarded a contract to Irwin & Leighton, 126 North Twelfth Street, for the erection of a one-story and two-story substation at Fifth and Federal Streets, 25 ft. x 65 ft. and 29 ft x 63 ft. respectively. Bids have been asked for the construction of a similar substation at Fifty-sixth and Race Streets.

PITTSBURGH, PA. — The West Penn Power Company contemplates the erection of three 22,000-volt transmission lines and two telephone lines across the Allegheny River.

PITTSBURGH, PA.—A number of electric companies are being organized by C. P. Morrison, E. P. Griffiths and J. R. McNary, 435 Sixth Avenue, to construct and operate power and light systems in different townships, as indicated by the name, as follows: The Kilbuck Township Light Company, the Stowe Township Light Company, the Kennedy Township Light Company, the Robinson Township Light Company, and the Neville Township Light Company.

RIDGWAY, PA.—The Keystone Power Corporation contemplates building an addition, 100 ft. x 100 ft., to its local plant.

YORK HAVEN, PA.—Work will soon begin on extensions to the local plant of the York Haven Water & Power Company. The plans provide for doubling the capacity of the plant, to cost about $1,000,000.

WOMELSDORF, PA.—The Womelsdorf Electric Company, recently organized, has acquired the local municipal power plant. Extensions and improvements will be made to the system, including the erection of new lines.

ILCHESTER, MD.—The Thistle Cotton Mills, Inc., will build an electric power plant at its textile mills. Charles M. Sears is secretary.

BOYDTON, VA.—The erection of a transmission line to connect Halifax and Charlotte, to cost about $50,000, is under consideration by the Staunton Power Company. E. L. Baptist is secretary.

HAMPTON ROADS, VA.—The purchase of coal and ash-handling equipment for the local naval base (Specification 4,663) is under consideration by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, until July 5 for 54,300 flashlights and batteries for Eastern and Western navy yards. (Schedule 13.)

North Central States

FLAT ROCK, MICH.—A power plant will be erected in connection with the new glass-manufacturing plant to be erected here by the Ford Motor Company, Detroit, to cost with machinery about $1,000,000. Albert Kahn, Marquette Building, Detroit, is architect.

CLEVELAND, OHIO. — The Cleveland Illuminating Company contemplates extensions and improvements during the year, to cost about $4,000,000.

CLEVELAND, OHIO.—Preliminary plans are being prepared by H. L. Porter, architect, 1900 Euclid Avenue, Cleveland, for a widows and orphans' home for the Army and Navy Union, consisting of a one, two and three-story hospital administration building, officers' quarters, gymnasium, academic school, library, church, twenty-four cottages, power house, workshop, etc., to cost about $5,000,000. E. McGeorge and A. G. Simon, 1900 Euclid Avenue, are engineers. E. Jeffrey, national commander Army and Navy Union, 1403 West Third Street, Cleveland, is in charge.

PAINESVILLE, OHIO.—Plans are being prepared for an addition to the municipal electric plant, to cost about $50,000. Hadlow & Hick, Finance Building, Cleveland, are engineers.

EVANSVILLE, IND.—The Southern Indiana Gas & Electric Company will build an addition to its local power plant, and make extensions to the system to cost about $700,000. A new 8,500 kw. generator will be installed at the local power house.

CHICAGO, ILL. — Hetzel & Company, 1739 Larabee Street, will build a power house at their meat-packing plant on Mohawk Avenue, 70 ft. x 120 ft., to cost about $60,000.

KEWANEE, ILL.—Bonds to the amount of $125,000 have been voted for the installation of a municipal electric light plant.

EAU CLAIRE, WIS.—The Chippewa Power Company has issued $1,800,000 in bonds, part of the proceeds to be useed for the construcion of a hydro-electric plant on the Chippewa River, to be operated by Wisconsin-Minnesota company under a thirty-year lease. The plans call for an initial installation of 15,000 hp., with an ultimate capacity of 20,000 hp.

FOND DU LAC, WIS.—The Middle West Utilities Company, Chicago, has acquired the Eastern Wisconsin Electric Company and will make extensions and improvements to the system.

GREEN BAY, WIS.—The Wisconsin Public Service Company contemplates extending its transmission line to Duck Creek.

LODI, WIS.—The Lodi Utilities Company contemplates the erection of an electric transmission line in Columbus County to connect adjacent towns, to cost from $40,000 to $50,000. W. F. Groves is interested in the company.

MARINETTE, WIS.—The Menomonie & Marinette Light & Traction Company is planning to extend its power and light service on the shore drive south of Marinette.

PINE CITY, MINN.—The Eastern Minnesota Light & Power Company contemplates the erection of a new local power plant. Extensions and improvements will also be made to the power plant at Milaca, Minn.

FORT DODGE, IOWA.—The Fort Dodge Gas & Electric Company is preparing plans for the erection of a 5,000-kw. power plant, to cost about $600,000. The plans provide for the installation of a second unit in the future.

WATERLOO, IOWA.—The Rath Packing Company will build a one-story power house at its local factory.

KANSAS CITY, MO.—A power house will be erected at the Unity School of Christianity at Tracy and Tenth Streets. Elmer E. Boillot, Scarritt Building, is architect.

ST. LOUIS, MO.—A power house will be erected in connection with the proposed new pottery on a site near St. Louis, to cost about $300,000, to be established by a company now being organized by W. S. Hooper, president of the Ozark Iron Ore & Manufacturing Company, Poplar Bluff, Mo., and associates.

ELLINWOOD, KAN.—Contract for the installation of a municipal ornamental street-lighting system has been awarded to the Ellinwood Electric Company.

KANSAS CITY, KAN. — Contract has been awarded to the E. A. Brown Electric Company, 715 Minnesota Avenue, for the installation of an ornamental street-lighting system in the district north of Eighteenth and State Streets, to cost $42,500.

Southern States

HOBGOOD, N. C.—The Council is considering an issue of $10,000 in bonds for the construction of a municipal electric light plant.

WILSON, N. C.—Plans are under consideration by the Municipal Electric Light Department to extend the transmission lines of the municipal electric light plant to the towns of Middlesex and Bailey to furnish electrical service.

SUMTER, S. C.—The City Council has decided to install an ornamental lighting system on Main and Liberty Streets in the business section.

ATHENS, GA.—The Council is considering the installation of an ornamental lighting system in the business district.

COLUMBUS, GA.—The Columbus Electric & Power Company has issued $1,500,000 in bonds, part of the proceeds to be used for extensions and improvements.

COCOANUT GROVE, FLA.—Bonds to the amount of $10,000 have been voted for improvements to the electric lighting system.

JACKSONVILLE, FLA.—The City Commission has engaged the Scofield Engineering Company, Philadelphia, as consulting engineer in connection with the proposed extensions to the municipal electric plant, including the installation of a 10,000-kw. generator. The cost is estimated at $280,000.

PUNTA GORDA, FLA. — Preliminary plans are being considered for the erection of a new municipal light and power plant.

QUINCY, FLA.—Bids will be received by the City Council until July 18 for extensions and improvements in the municipal power plant, including one 210-kva. electric generator direct-connected to "Unaflow" engine; three-panel switchboard; two centrifugal pumps, motor-driven; one 500-hp. feed pump and heater; one air compressor, motor-driven; one condenser, and one 200-hp. return tubular boiler. The J. B. McCrary Engineering Corporation, Atlanta, Ga., is engineer. J. P. Smith is clerk of Council.

ST. PETERSBURG, FLA. — Bonds for $300,000 have been approved for the construction of a municipal power plant and system.

CHATTANOOGA, TENN. — The Dixie Spinning Company will build a power house in connection with its proposed local textile mill, to cost about $500,000.

DUCKTOWN, TENN.—The Ocoee Copper Company, Volunteer Life Building, Chattanooga, Tenn., will build a power house in connection with its new flotation plant, to cost about $200,000. J. I. Carter is president.

GRAYSVILLE, TENN.—The Dixie Coal, Lime & Clay Products Company will build a power house in connection with its proposed local brick plant. O. E. Thomas is president.

ALICEVILLE, ALA. — J. V. Park is organizing a company to construct and operate a hydro-electric power plant on the Sipsey River, with local distributing system, to cost about $75,000.

ANNISTON, ALA.—The installation of an ornamental lighting system in the business section is under consideration.

ARTESIA, MISS.—The installation of a municipal electric light plant is under consideration.

HATTIESBURG, MISS.—The Love Lumber Company, Poplarville, Miss., contemplates the erection of a new power house at its local plant. R. N. Stadman is president.

CAMDEN, ARK.—The Council voted to install an underground conduit system on Washington and Adams Streets, to cost about $20,000.

DUNCAN, OKLA. — Contract has been awarded to the Merkle Machinery Company, Kansas City, Mo., for the construction of a distributing system and ornamental street-lighting system. Arthur L. Mullergren, Gates Building, Kansas City, Mo., is engineer.

FAIRLAND, OKLA.—Bids will be received by the Board of Trustees until June 30 for the erection of an electric distributing system in Fairland. H. G. Olmsted & Company, Tradesmen's National Bank Building, Oklahoma City, are engineers.

GAGE, OKLA. — Contract has been awarded to E. A. Brown & Company, Kansas City, Kan., for the construction of a municipal electric plant. H. G. Olmsted & Company, Tradesmen's National Bank Building, Oklahoma City, are engineers.

FORT WORTH, TEX. — The Magnolia Petroleum Company is planning to install a series of electrically operated pumping stations in connection with its pipe line from Fort Worth to Corsicana.

Pacific and Mountain States

SPOKANE, WASH. — The Washington Water Power Company, we are informed, does not contemplate the construction of a new hydro-electric plant at lower Spokane Falls or rebuilding its plant at the Monroe Street Bridge, as reported in the issue of June 17. The company may make some repairs at the latter plant this season.

PORTLAND, ORE.—The present steam-driven power plant of the Portland Railway, Light & Power Company is to be dismantled and replaced with a 3,000-kw. turbo-generator. New boilers and auxiliary equipment will also be installed. The cost is estimated at about $170,000.

WHEELER, ORE.—Harvey E. Rinehart, Wheeler, is organizing a company to construct and operate a hydro-electric power plant on Classic Lake, with transmission and distributing system. Application for permission has been made to the State Engineer.

BAKERSFIELD, CAL.—Plans are being prepared for the installation of an ornamental lighting system on Chester Avenue from Fifteenth to Twenty-fifth Street.

BUTTONWILLOW, CAL. — The San Joaquin Light & Power Corporation, Fresno, contemplates an addition to its local steam-driven power plant, to cost about $1,250,000, including equipment.

LOS ANGELES, CAL. — The Southern California Edison Company will build a two-story substation on Moulton Street, near Main Street, to cost about $40,000.

LOS ANGELES, CAL.—The Mutual Dairy Company will build a power house in connection with its new bottling plant at Naomi and Walnut Streets. Clifford A. Truesdell, Jr., Purington & Newton, San Fernando Building, are engineers.

LOS ANGELES, CAL. — The Lighting and Power Bureau will install ornamental lamps on portions of Hayworth Avenue, North Main Street and Buckingham Road.

LOS ANGELES, CAL.—The Little Rock Power & Water Company, Chapman Building, has applied to the State Water Power Commission for permission to build a hydro-electric power plant to develop 2,440 hp., at a cost of about $350,000.

MARE ISLAND, CAL.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates extensions to the power house at Mare Island (Specification 4,665).

TRACY, CAL.—The Banta-Carbona Irrigation District contemplates the installation of new electric pumping machinery, etc., to cost about $250,000.

BOISE, IDAHO. — The Federal Power Commission has granted the city of Boise a preliminary permit for the use of certain lands in and out of the Payette National Forest for the construction of a municipal hydro-electric plant on the north and south forks of the Payette River, near Banks, to develop 12,000 hp.

HOLBROOK, ARIZ.—The Holbrook Light & Power Company has been granted permission by the Public Service Commission to issue $30,000 in capital stock, part of the proceeds to be used for the installation of an oil-engine-driven unit.

CASPER, WYO. — The Natrona Power Company has awarded a contract for the construction of a new power house on East Railroad Street between Beach and Kimball Streets.

CASPER, WYO.—A power house will be constructed in connection with the proposed new oil refinery (in this section) of the Texas Company, 17 Battery Place, New York, N. Y., to cost about $500,000.

Canada

BURGOYNE, ONT.—The Ontario Hydro-Electric Power Commission, Toronto, is considering a hydro-electric development on the Saugeen River at Burgoyne, to cost about $500,000. A. Jeffrey, 190 University Avenue, Toronto, is engineer.

PAPINEAUVILLE, QUE.—The Papineauville Electric Company, Portage de la Nation, is planning to erect a new local power house, to cost about $30,000.

GALT, ONT.—Plans are being prepared by the Hydro-Electric Power Commission for erecting a 2,200-volt transmission line in rural districts, to cost about $28,000. A. B. Scott is engineer.

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Electrical World

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W. H. ONKEN, JR., and D. H. BRAYMER, *Editors*

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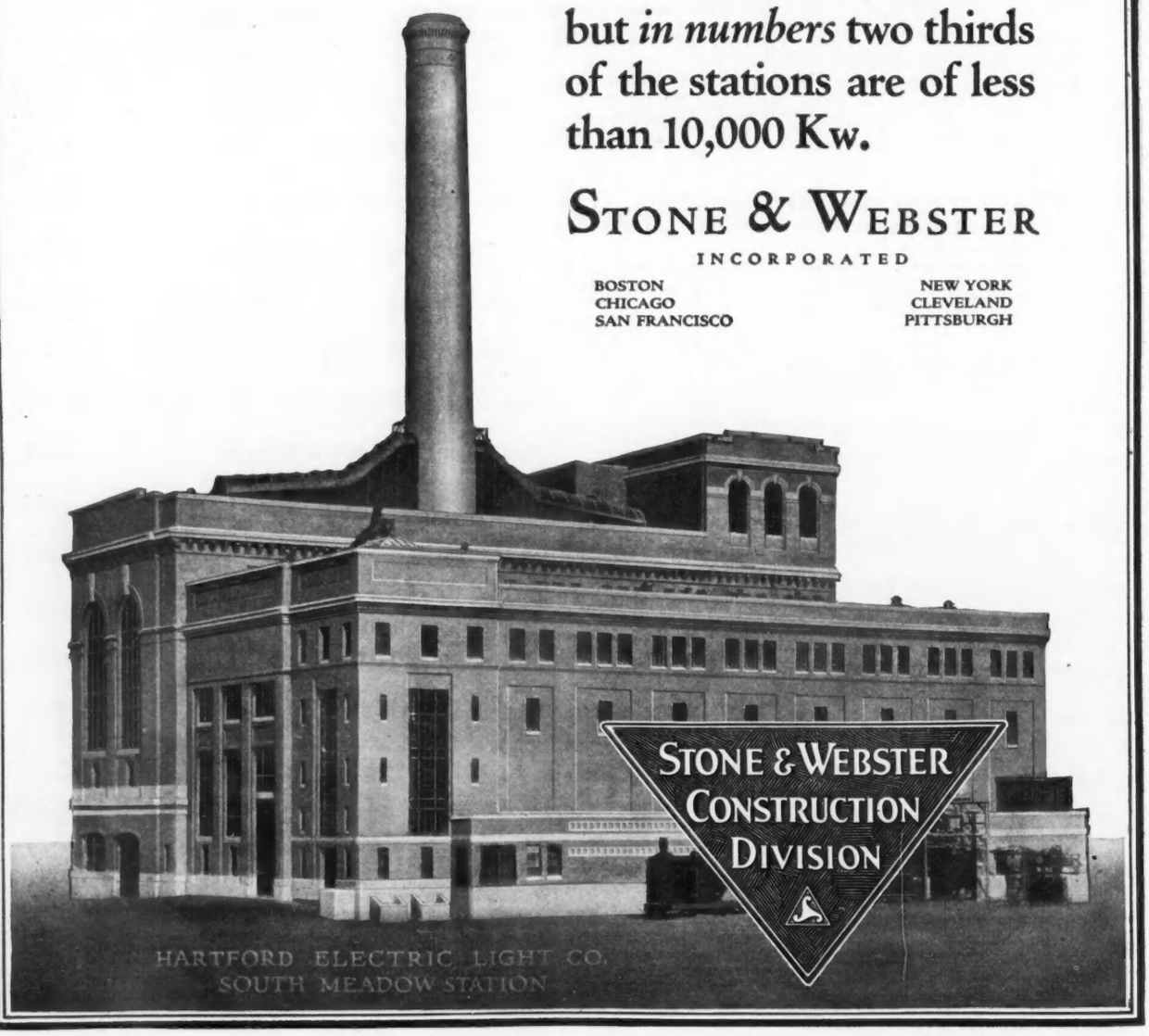

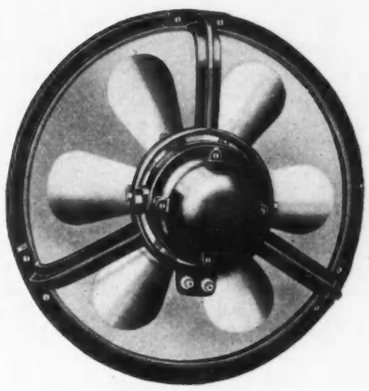

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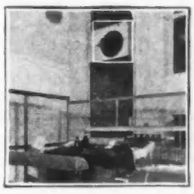
Exhaust Fans
12 in. and 16 in. diameter

Western Electric
Ventura Type Exhaust Fan
48 in. diameter and smaller

Western Electric Ventilating (Exhaust) Fan



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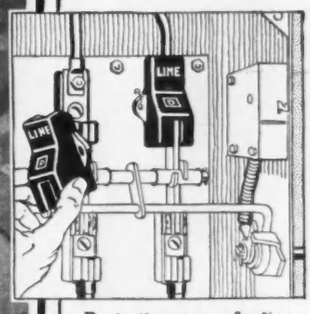

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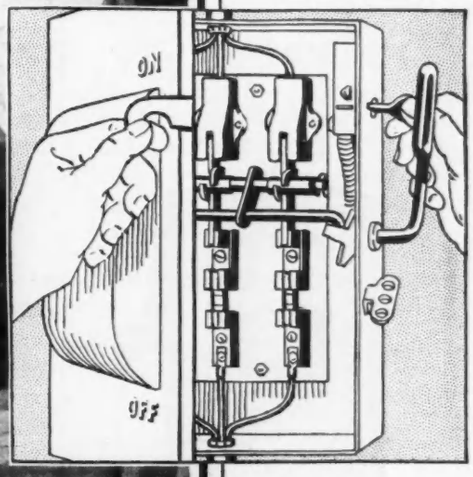

Powerful quick make and quick break mechanism enclosed to prevent clogging by dust etc.

Safety Switch

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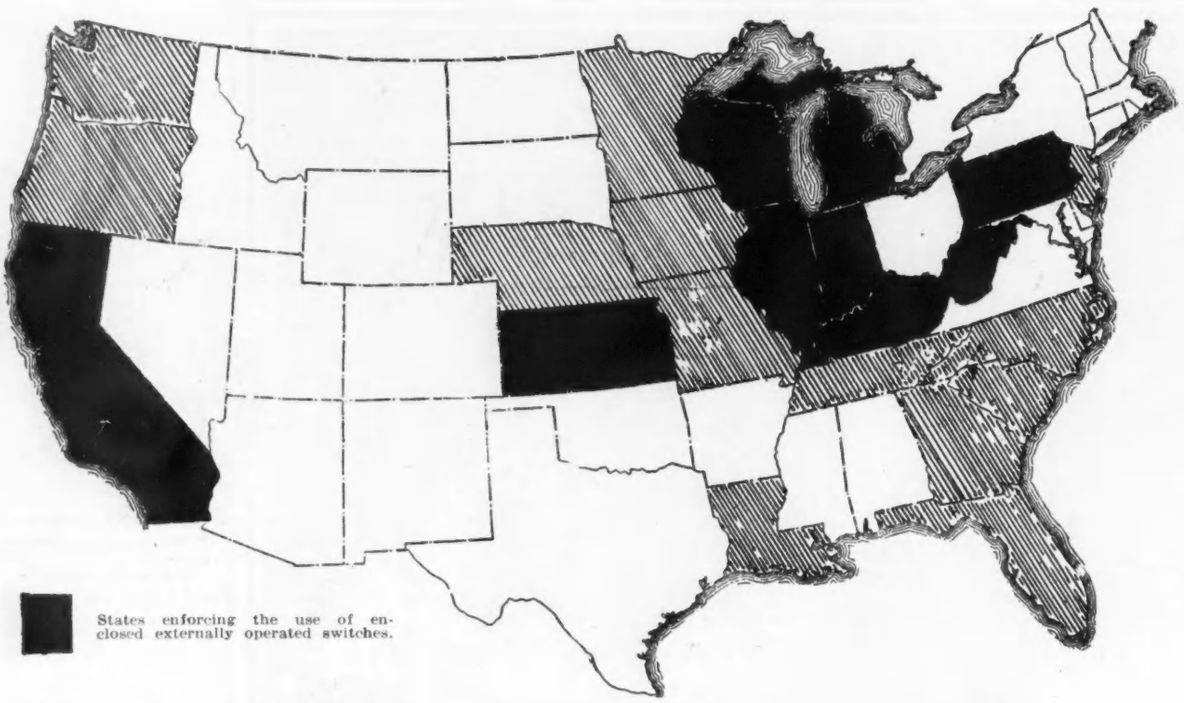

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Already California, Kansas, Michigan, Wisconsin, Illinois, Indiana, Pennsylvania and West Virginia have passed laws making compulsory the use of totally enclosed switches. Large cities in a score of other states have done likewise. A few years more and switches which protect against fire and accident will be required in every state.

And whether you're standardizing on a "AA," "A" or "B," there is a Compro to meet every requirement.

One switch, however, which stands out strongly as possessing those qualities which will soon make it the leader among safety switches, is the Class "A" type Compro.

Here is a switch that absolutely eliminates contact with current carrying parts—has provision made for locking or sealing—and permits of fuse renewal through opening shown in the cover although it is impossible to open fuse compartment without first opening switch, or to close switch without first closing the fuse opening. Moreover, the fuse base and holder are detachable for connecting the wiring.

Investigate this and other Compro Switches. Catalog 3 containing 116 pages on safety switches will bring you full details. Every plant superintendent, electrical engineer and purchasing agent needs this book on his shelf. Write today.

The Wadsworth Electric Mfg. Co.
Incorporated
Covington, Ky.

BRANCH OFFICES:

New York City	Chicago, Ill.	Boston, Mass.	Pittsburgh, Pa.
50 Church St.	559 West Monroe St.	176 Federal St.	422 First Ave.

Wadsworth Electric Mfg. Co, Covington, Ky.

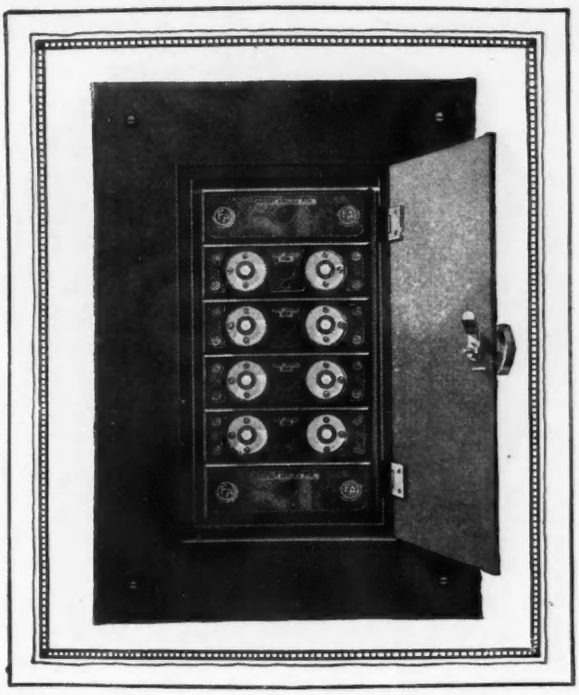
Gentlemen:

Please send data and prices on Compro Switches that promote safety and economy.

Name .....
Address .....
Company .....
Title .....

E-W

Announcing the New Triumph Type "R" Panel Board



Safety where *Safeness* is needed

The development of safety panel boards for residences has heretofore been greatly out-distanced by the improvement in those for business and industrial uses. Yet, where is safety of more vital importance than in the home? Women and children with the present equipment and without knowledge of the danger, coming in contact with the house circuit fuses can be painfully burned.

Recognizing the existence of this menace, we have devised a Residence Panel Board that is absolutely safe in every particular. It is the new Type "R" Triumph Panel Board.

Every live contact, every wire and piece of current-carrying metal has been covered securely and permanently. With even the most careless handling there is not the slightest possibility of electric shock or shorting.

This thorough protection will give this new member of the Triumph Line instant acceptance. It has other advantages resulting from a complete standardization of all the varied types of residence panel boards into one standard unit—*one* panel board to fit *all* requirements.

This new design saves in manufacturing cost by increased production, in a greatly decreased selling cost and in simplified installation.

The new Triumph Type "R" ready for delivery soon. Full description, prices and specifications in our Bulletin No. 27—send for your copy now.

DISTRICT OFFICES:
Detroit, New York, Dallas, Minneapolis, Kansas City, Cincinnati, New Orleans, Chicago, San Francisco, Los Angeles, Seattle.

Frank Adam
ELECTRIC COMPANY
ST. LOUIS

MANUFACTURERS ALSO OF:
Major systems, panel boards and cabinets, knife switches, safety switches, fan hanger outlets, reversible-cover floor boxes and A. C. and D. C. Distribution Switchboards.

The Triumph Line of *Standardized* Safety Panel Boards

PERFECTION in the manufacture of watthour meters, as in all other lines of endeavor, consists of trifling details worked out with care and skill. Details that would seem inconsequential even to the engineer accustomed to painstaking care, become of great importance in the finished meter.

Instruments of precision, carefully made and carefully used in the laboratory are the object of long study on the part of scientists and engineers. And they require the most careful handling if their delicate accuracy is to be retained.

What, then, of the instrument often placed in unfavorable locations, subject to variations from normal line conditions, receiving only periodic attention, and depended upon for a high degree of accuracy. The care and attention must be concentrated upon watthour meter design and construction in the factory, so that there will be no need for frequent attention afterwards.

We would not imply that Duncan Meters are perfect, nor do we think any other manufacturer would allow that claim to be made for his products. But we do know that the care and skill in details of design and in many operations of manufacture go to the utmost lengths to secure superior service from Duncan Meters. These things are all details, many of them seemingly unnecessary, but they make Duncan Meter performance a very close approach to perfection.

To meter engineers and utility managers who are interested, we will be glad to describe the distinctive features of Duncan Meters. Or, we will refer you to users who know from experience the superior accuracy and long time service that our care of manufacture insures.

Duncan Electric Manufacturing Co.

Lafayette, Indiana

CONDIT

"STANDARD" SEMAPHORES

LOAD BY TEMPERATURE

The load transformers will carry depends upon their temperature. In some climates they can be operated 50% and more above their rated capacity without damage.

Loading by temperature secures a greater net return from distributing systems with the same core loss. It cuts down the investment and overhead.

Temperature indications can best be secured by the use of CONDIT "Standard" semaphores with their double indication. They tell you when excess capacity is available.

They take the temperature at the vital spot—an important detail for reliability.

They are simple in construction, accurate and reliable in operation, visible and easy to install.

They provide an economical, efficient, and safe method of transformer loading.

Have us tell you more about them.

Write to Dept. S

Sold exclusively by

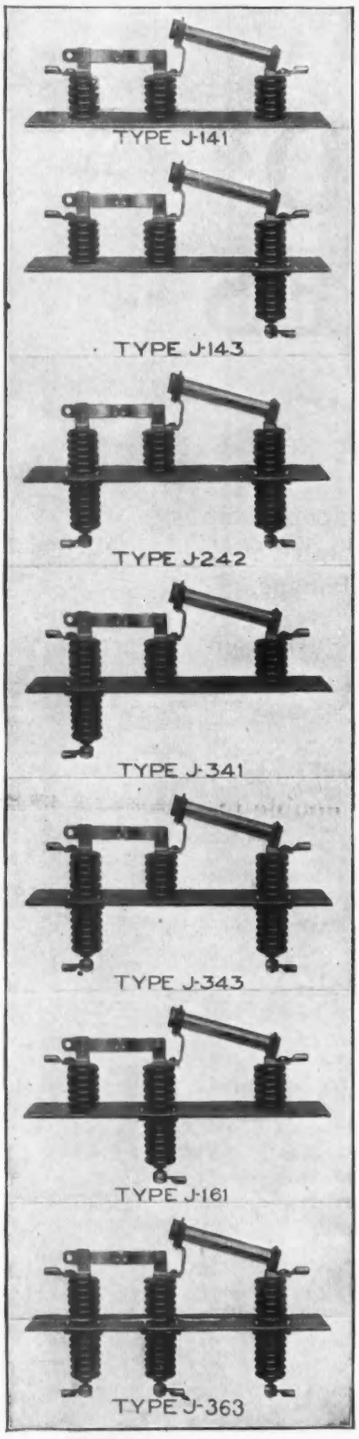
CONDIT ELECTRICAL MFG. CO.
BOSTON 27, MASS.

Represented in Principal Cities of U. S.

122-49

HIGH TENSION EQUIPMENT

Would You Build Your Own Automobile?



WOULD you build your own automobile or truck, motor or starter, just because you had a man on the payroll who was handy with tools? In these days of highly developed automobile manufacture and dependable service it is not economical to use up time in building a car in your own shops.

Just so with station switching and bus support equipment. A specialized organization, devoting its entire time to the design and construction of a particular class of equipment, builds better equipment and gives greater service. The substantial character of the equipment produced, the accuracy with which it meets your conditions and the continued low maintenance expense assured by this specialized manufacture all make it desirable.

DELTA-STAR is such an organization. Our "Unit Type" Switchboard and switching equipments have behind them a specially trained organization and a record of service that means dollars to you.

Write for our catalogs and see for yourself why DELTA-STAR equipment is the kind to use.

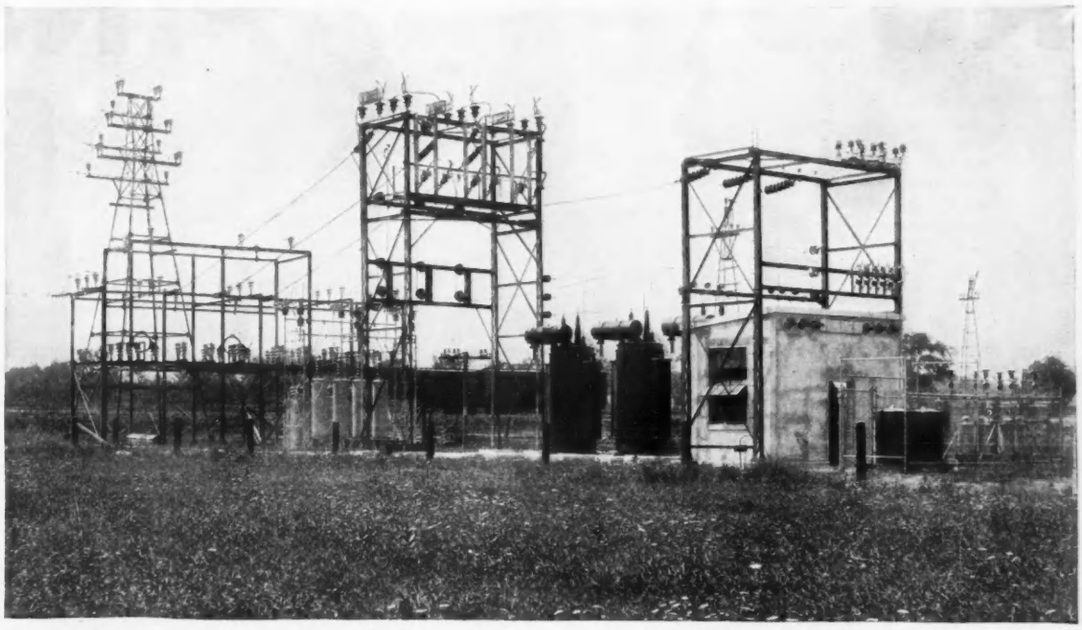
Unit-Type Bus Support with Fitting to Clamp Beam Up to 24 Inches Adjustable Top and Bottom

DELTA-STAR HIGH TENSION EQUIPMENT

UNIT-TYPE INTERCHANGEABLE PARTS

HIGH TENSION EQUIPMENT

No "Customer Ownership Campaign" Can Succeed Without Skillfull Advertising



A Unit-Type Substation Continually Advertising the Public Utility with a Frank, Direct, Telling Message.

A successful utility executive says:

"No customer-ownership campaign can succeed without skillful and adequate advertising. The very nature of the undertaking makes it necessary to address the whole public and to carry the message to every person in the community who can be induced to receive it. Upward of one-half of the whole equipment needed for customer-ownership effort consists of advertising—newspaper, direct-by-mail, follow-up literature, etc. The advertising necessarily covers the whole basis of approach to the public. If the advertising is out of line with public acceptance, if it presents the innovation in a bungling manner, or if it is overdone or underdone in quantity, success cannot be expected."

A Real Effective Advertisement

is a neat steel tower outdoor substation. It adds the impression of dignity to the fascination which always, in the mind of the public, is attached to high voltage electricity.

To the small town citizen the impression made by the local outdoor substation represents his conception of the public utility company and every individual in the town sees the substation time and again—it is an advertisement every day in the year. Why install a shaky looking wood pole substation when there is so much at stake?

DELTA-STAR ELECTRIC CO., 2433-59 Fulton Street, Chicago, Ill.

Manufacturers of High Tension Equipment

New York, N. Y., 25 Broad St.
Boston, Mass., 294 Washington St.
Rochester, N. Y., 119 Main St., E.
Syracuse, N. Y., City Bank Bldg.
Buffalo, N. Y., 595 Ellicott Square
Kansas City, Mo., Interstate Bldg.
St. Louis, Mo., Railway Exchange
Salt Lake, Utah, 313 Dooly Bldg.

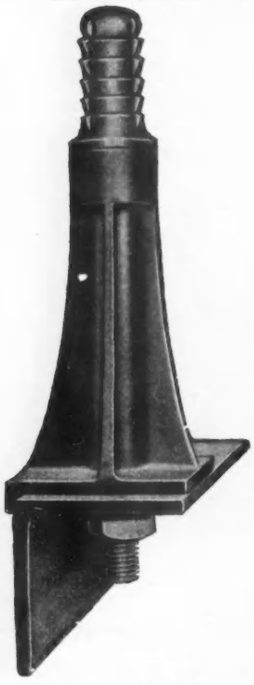
Toronto, Ont., 67 Yonge St.
Indianapolis, 518 Trac. Term. Bldg.
Seattle, Wash., Hoge Bldg.
Philadelphia, Pa., 1333 Real Estate Trust
Columbus, Ohio, 600 Joyce Realty Bldg.
Minneapolis, Minn., 310 Security Bldg.
Los Angeles, Cal., 411 South Main St.
Denver, Colo., 1633 Tremont St.

Pittsburgh, Pa., Union Arcade
Soc. Francaise Ohio Brass & Electric, 7 Rue de Tilsitt, Paris, France.
A/S, Kraftoverforing, Kristiania, Norway.
Carrick Wedderspoon & Co., Christchurch, New Zealand.

DELTA-STAR HIGH TENSION EQUIPMENT

UNIT-TYPE INTERCHANGEABLE PARTS

KEYSTONE TRUSS PINS



This type of Keystone Truss Pin is used for Steel Angle Cross Arms.

Keystone Round Top Wood Cross Arm Type.

Keystone Flat Top Wood Cross Arm Type

2,000,000

In Use

No man needs better proof of the superior qualities of Keystone Truss Pins than "2,000,000 in use." They provide Security — Sturdiness — Reliability and Mechanical Safety—all that their trade-name "Keystone" implies. You'll see them on pole tops, the world over, giving full satisfaction to the men who purchased them.

Send for data sheets

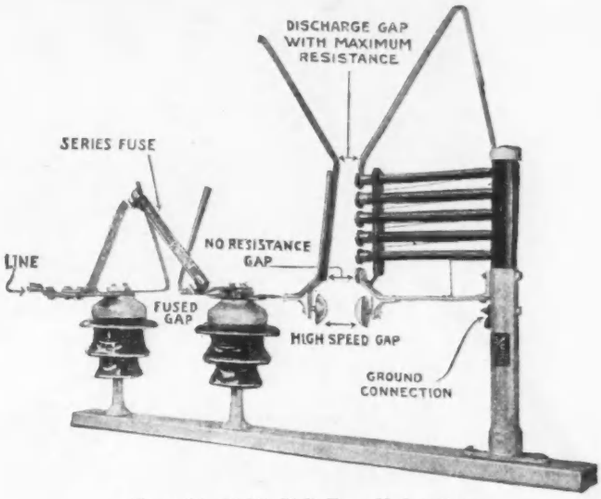
ELECTRIC SERVICE SUPPLIES CO.

Manufacturer of Railway Material and Electrical Supplies

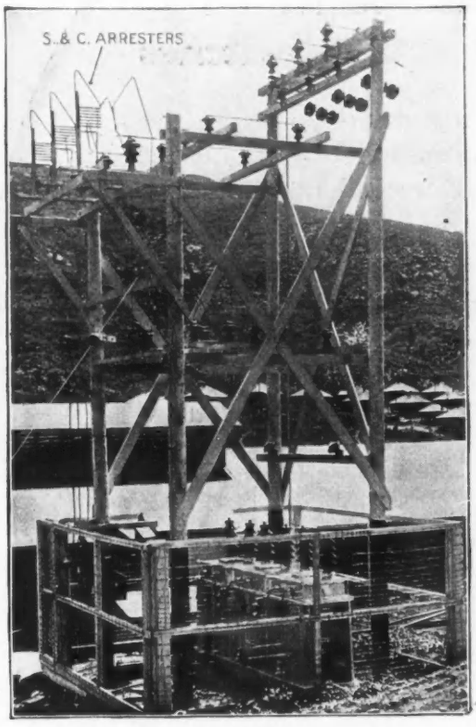
PHILADELPHIA 17th and Cambria Streets — NEW YORK 50 Church Street — CHICAGO Monadnock Building

Canadian Distributors: Lyman Tube & Supply Co., Montreal, Toronto, Winnipeg

S & C Lightning Arresters



Form 3A, 25,000 Volt Type H Arresters



44,000 Volt, Form 1, Type H Arresters

Instantaneous Relief Without Disturbance to the System

Effective Protection is only secured from a Lightning Arrester which successfully discharges the high potential surge, prevents the excessive flow of dynamic or generator current, and does this *without itself producing other disturbances* on the system.

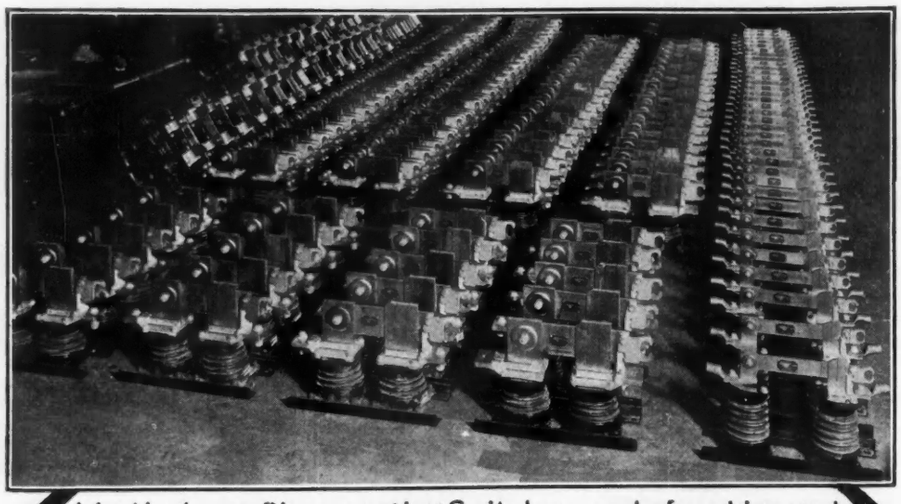
S&C Type H Graded Resistance Sphere Gap Lightning Arrester consists of a Horn Gap with a Subdivided Resistance so arranged that the discharge *adjusts itself automatically* to the correct value of resistance according to the energy capacity of the discharge. That this ingenious arrangement of the resistances effectively handles discharges of large or small volume is attested to by the every-day operation of the ***S&C*** Type H Arrester on important circuits of many of the largest utilities in this country, where they have been in operation for years.

Are you getting this class of protection on your important high voltage lines?

SCHWEITZER CONRAD, INC.

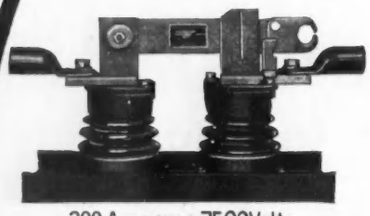
4435 RAVENSWOOD AVENUE CHICAGO, ILLINOIS U.S.A.

New York, 50 Church St., Room 2070.
Buffalo, 950 Ellicott Square Bldg.
Boston, Mass., 88 Broad St., Room 910.
Pittsburgh, Pa., 1306 Keenan Bldg.
Cleveland, Ohio, 1202 Illuminating Bldg.
Minneapolis, 915 Metropolitan Life Bldg.
St. Louis, 1004 Federal Reserve Bank Bldg.
Kansas City, 717 Bryant Bldg.
Omaha, Nebr., 513 Electric Bldg.
Denver, Colo., Denham Bldg.
Los Angeles, 211 I. W. Hellman Bldg.
San Francisco, 76 Folsom St.
Seattle, Room 1427, L. C. Smith Bldg.
Portland, 308 Lewis Bldg.
Winnipeg, Man., 703 Confederation Life Bldg.
Vancouver, 609 Credit Foncier Bldg.
Toronto, 24 Adelaide St., East.
Montreal, 134 Coristine Bldg.



Westinghouse Disconnecting Switches ready for shipment

Discriminating Engineers Specify Westinghouse Type S Disconnecting Switches



200 Amperes, 7500 Volts

200 Amperes, 25,000 Volts

BECAUSE they stand up under the enormous mechanical strains incident to severe short circuits.

One of the most complete and exhaustive series of tests ever run on disconnecting switches emphasizes these important characteristics of the type S switch:

A lock that is absolutely dependable.

The lock cannot fail thermally because it carries no current.

The lock is not supported by, and is separate mechanically from the break jaw, so that possible spreading of the jaw blades cannot unlatch it.

Mechanical stresses, which act to spread the insulators apart and to blow the switch blade open—only tighten the grip of the Type S latch.

The hinge jaw blades are solid (not split) preventing the hinge bolt from pulling out with the resultant opening of the circuit at the hinge jaw.

The hinge and break jaws are permanently sweated and pinned to jaw blocks.

The large head and broad base of the insulators furnish sturdy mechanical support.

Ample cross section of copper parts and rugged construction of all fittings, assure the full utilization of all the other superior points of construction.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

W WESTINGHOUSE ELECTRIC

Westinghouse

Westinghouse Porcelain Strain Insulators

Manufactured by Wet and Dry Processes.

Tensile Strength Greater than Cable

For high and low voltage service

Westinghouse Porcelain Strain Insulators are made of a grade of porcelain much superior to that ordinarily used for such appliances. Their glaze is of a uniform brown color so that the insulators do not readily attract attention. Sharp corners, that would be apt to chip, have been avoided, and the shape of the grooves is such that the wires lie naturally in them. Large creepage distance between the cables is also provided.

These insulators will stand more strain than the cable ordinarily used in line construction. For this reason the danger of breaking is entirely removed.

There is a size and design to meet every service requirement for dead ending lines, and for insulating guy wires.

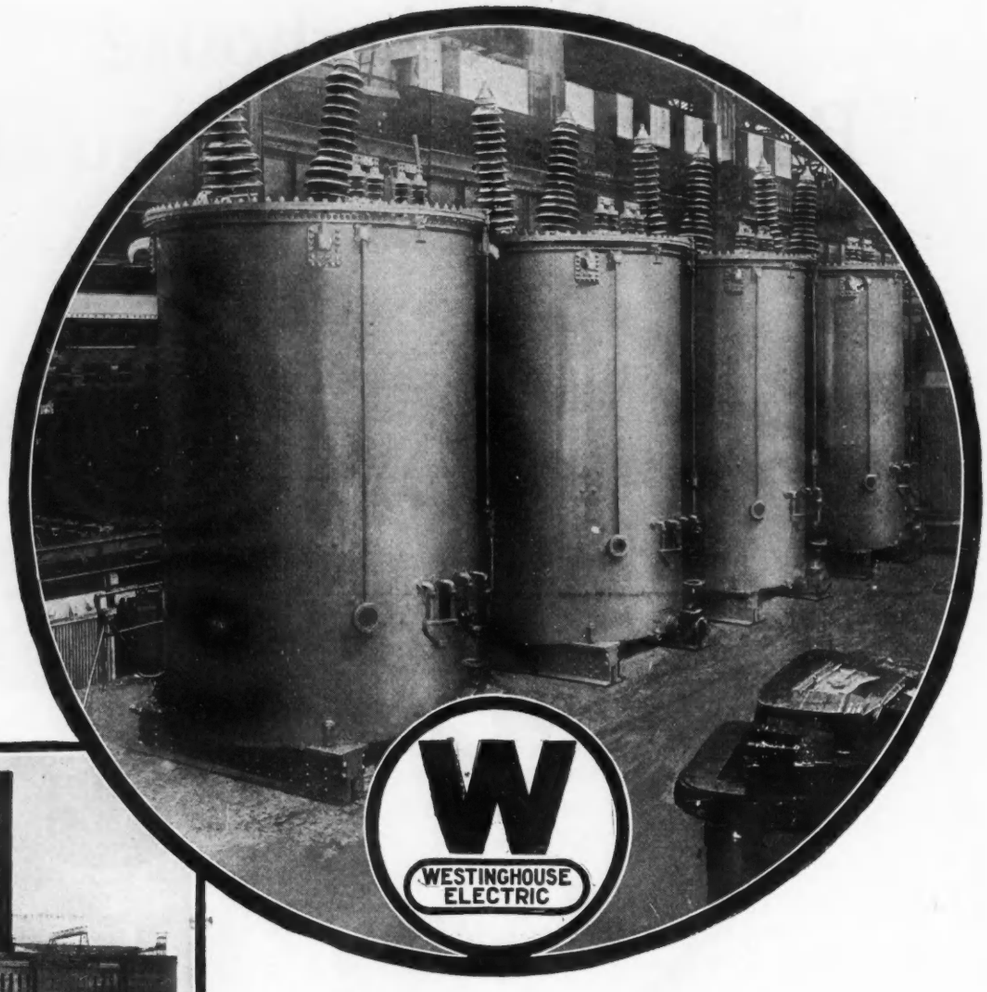
Westinghouse Electric & Manufacturing Company

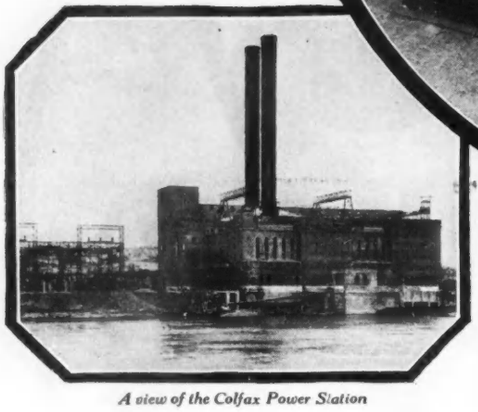
Agents for Westinghouse High-Voltage Insulator Company

Successors to Pittsburgh High-Voltage Insulator Company

General Office and Works, Derry, Pa.

Westinghouse





A view of the Colfax Power Station

Westinghouse Power Transformers

The main transformer installation at the Colfax Station of the Duquesne Light and Power Co. consists of four Westinghouse 23,600 kv-a. transformers, stepping up the generated voltage of 12,000 volts to 66,000 or 132,000 volts.

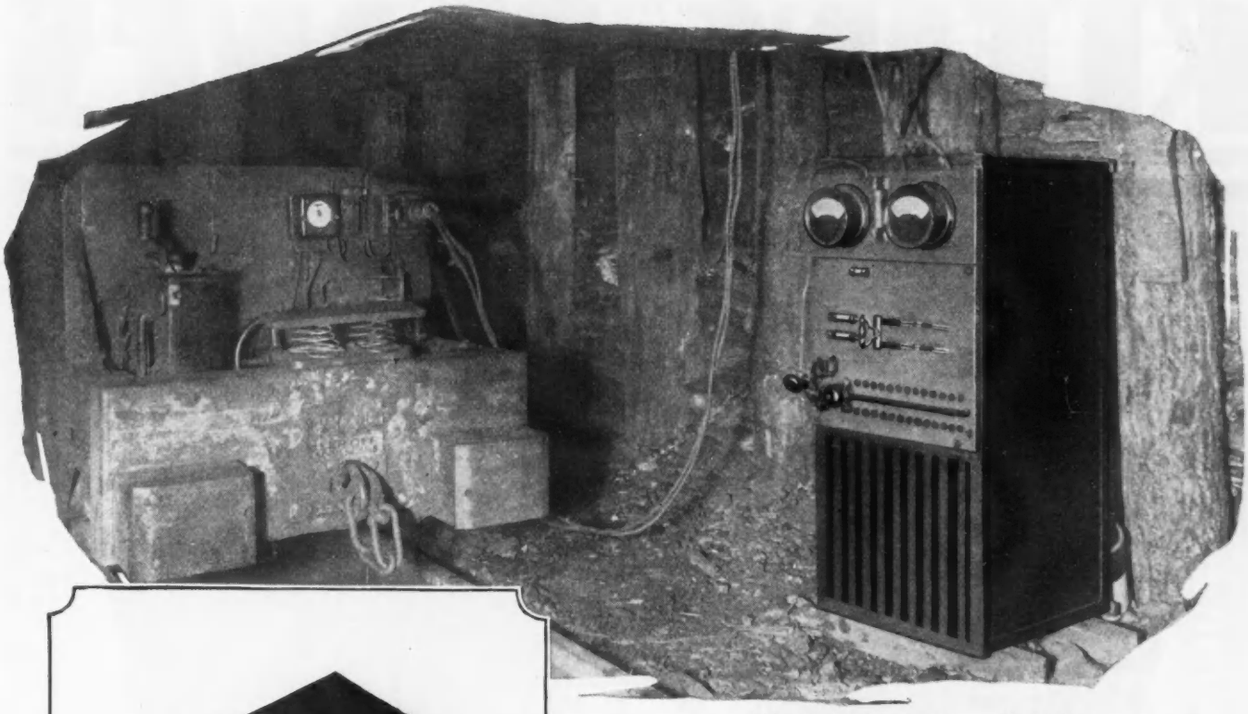
The station transformers consist of three Westinghouse 833 kv-a. units, stepping the current down from 12,000 to 2,300 volts.

In addition to these, the starting, station lighting and auxiliary power transformers are all Westinghouse.

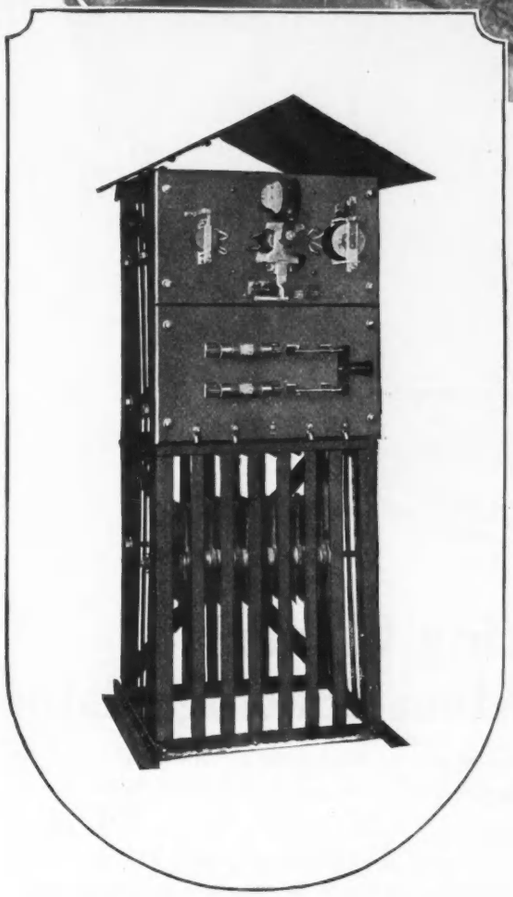
The main transformers in this station have a rated capacity greater than any single-phase, two winding transformers heretofore built, and at the same time, are among the most efficient high-voltage transformers in service, having an efficiency of over 99 per cent at full load.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.
Offices in All Principal American Cities

Westinghouse



Mancha Mule being charged by C-H
Mine Type Charging Panel



The C-H *Charging Panel may be located at the point where the locomotive ends or starts its day's work, thus eliminating unnecessary mileage.*

Putting the Kick in the Mule

The tapered charge fed to storage batteries by C-H (Mine type) Battery Charging Equipment is provided without manual adjustment and the rate is kept at a *safe* value at all times, insuring absolute uniformity of all charges from day to day.

This one feature gives "C-H-charged" batteries full restored power, long life, and low maintenance.

The automatic Low Voltage Protective Relay prevents connection to the lines at all times, when the line voltage is too low for charging. This insures against draining of batteries through discharge back into the lines.

But after a temporary failure—an operator need not chase around to re-connect the battery — the C-H Automatic Re-Closing Relay re-established the circuit. There is no attention required from the operator, and there is no danger of finding the batteries uncharged when the operator comes to take out the locomotive.

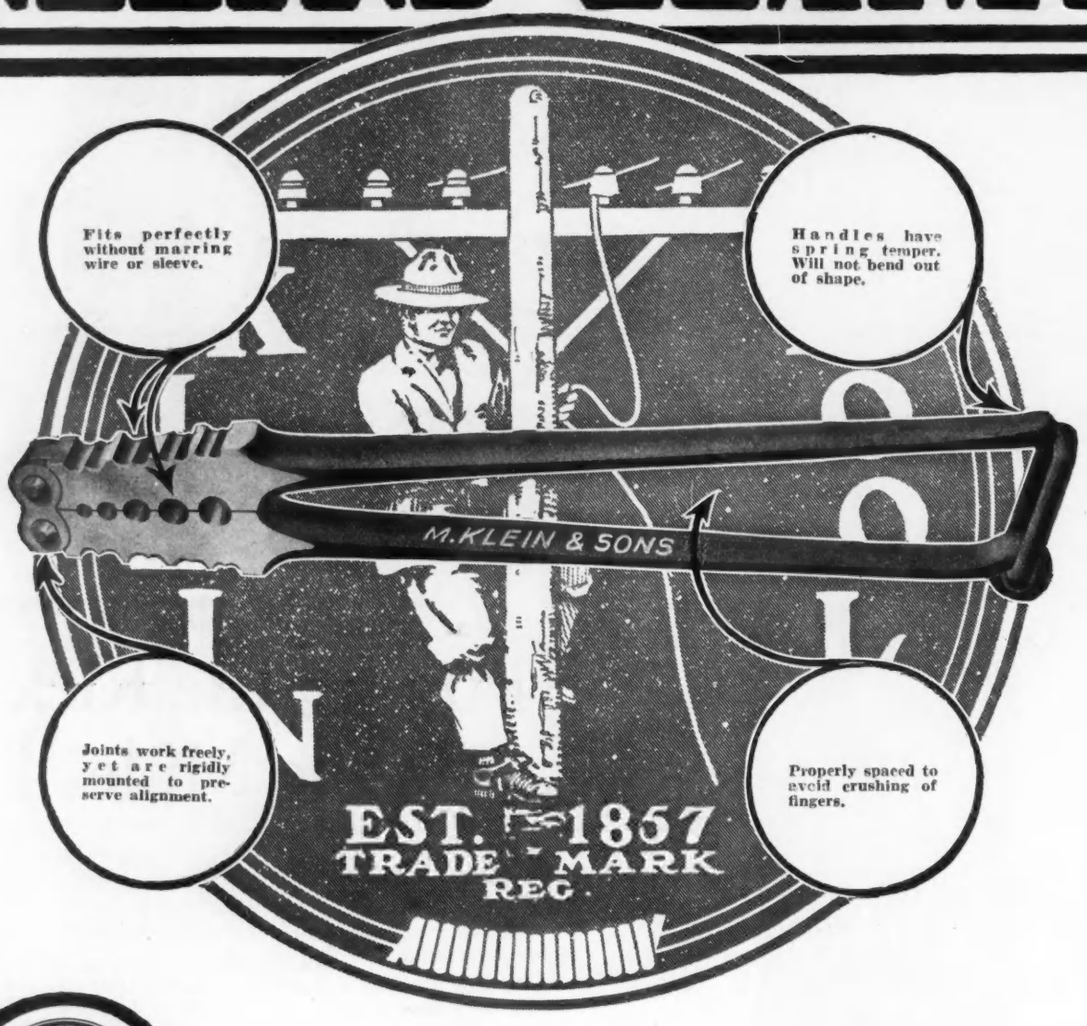
When fully charged a Tripping Relay, used in conjunction with an ampere-hour meter on the locomotive, disconnects the batteries.

C-H Mine Type Battery Charging Equipment takes all responsibility out of human hands—a complete description is contained in Publication 836. Let us mail you a copy.

THE CUTLER-HAMMER MFG. CO.
Motor Control Department
Works: **MILWAUKEE** *and* **NEW YORK**
Offices and Agents in Principal Cities
Northern Electric Co., Ltd., Can.

C-H CHARGING EQUIPMENT

KLEINS CLAMPS


Fits perfectly without marring wire or sleeve.
Handles have spring temper. Will not bend out of shape.
M. KLEIN & SONS
Joints work freely, yet are rigidly mounted to preserve alignment.
Properly spaced to avoid crushing of fingers.
EST. 1857
TRADE MARK
REG.

KLEIN TOOLS

Pliers
Splicing Clamps
Sleeve Twisters
Climbers
Tool Belts
Safety Straps
Lag Screw Wrenches
Wire Grips
Tree Trimmers
Tool Bags
Charcoal Furnaces
Staysalite Torch

The First Splicing Clamp Was a Klein Splicing Clamp!

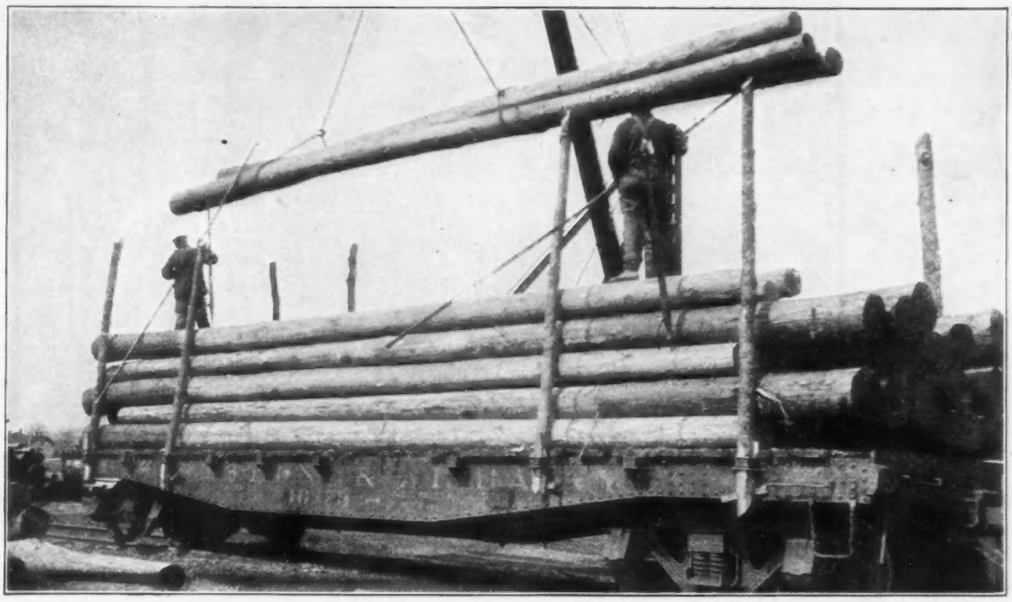
It is a fact that the Klein Splicing Clamp is the ancestor of all splicing clamps. Sixty-seven years of experience in making linemen's tools still keeps it the first!

The old-timers know that specially designed joints permit a Klein Splicing Clamp to work freely without loss of alignment—that the handles are properly spaced to avoid crushing of fingers—and that the dies are snugly fit to gage and will not injure the wire or sleeves when twisted.

Equip your outside gangs with the best! Buy Klein Splicing Clamps!

Mathias KLEIN & Sons

Established 1857 — Chicago, Ill. U.S.A.



NAUGLE POLES

Service—our corner-stone—is employed to the complete satisfaction of all our customers. 24-hour loading from centrally located concentrating yards.

Uniformity makes for a good-appearing pole line. Care in selection of your poles is emphasized by our yard men, who cooperate in our endeavor to satisfy you.

Proper Butt-Treatment at our modern plants serve to make your poles last a lifetime. We PENTREX treat—half-inch penetration guaranteed. Send for our free book just issued, "Butt-treatment of Cedar Poles."

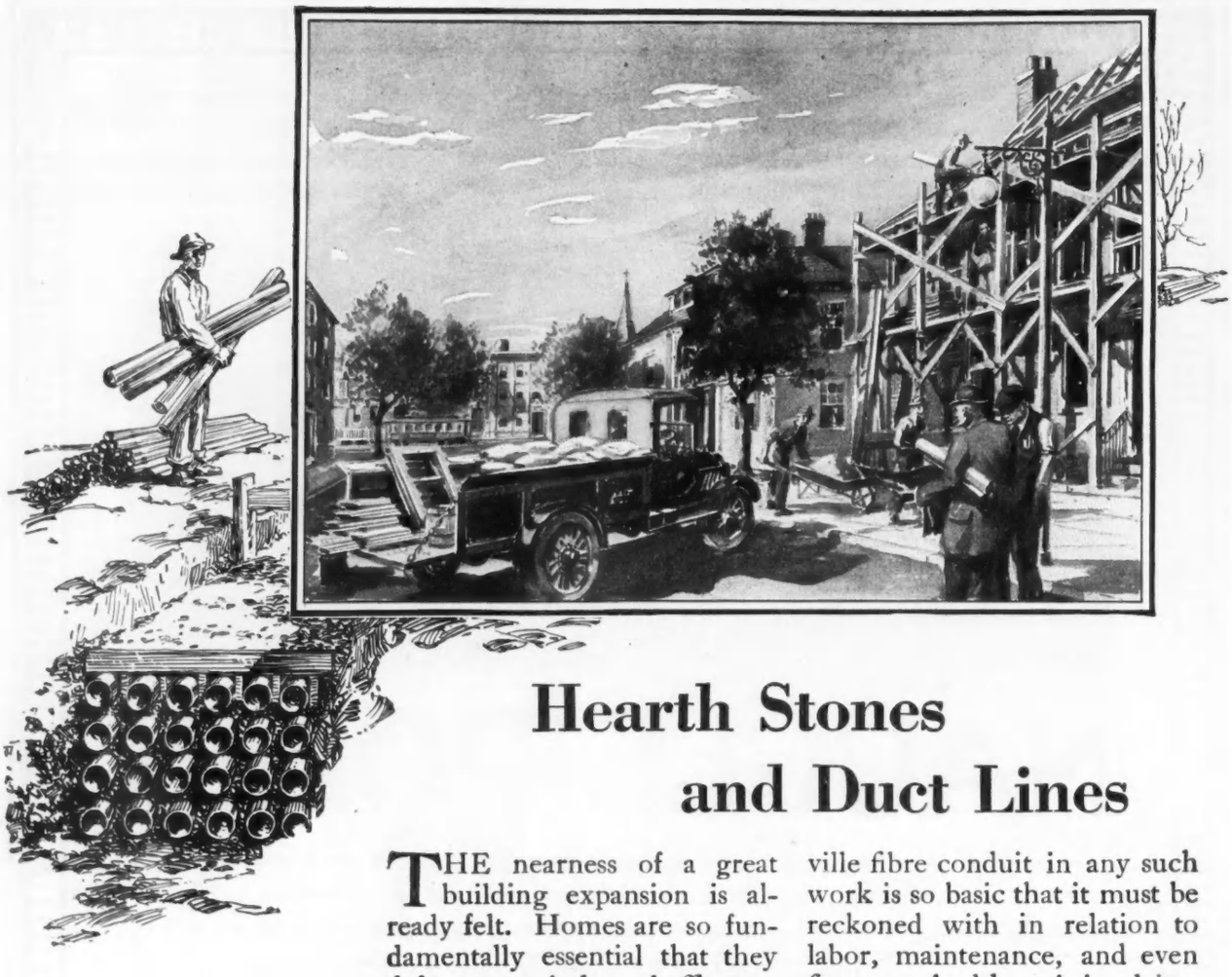
NAUGLE
—*SERVICE* gratifies
—*PRICE* satisfies
—*QUALITY* identifies

Northern and Western Cedar

NAUGLE POLE & TIE CO.

5 South Wabash Ave., Chicago, Ill.

Branches: *New York, Columbus, O., Kansas City, Boston, Spokane*
Main Yards: **Chicago,* **Pinconning, Mich., Green Bay, Wis.*
**Pentrex and treating plants at these yards.*



Hearth Stones and Duct Lines

THE nearness of a great building expansion is already felt. Homes are so fundamentally essential that they defy economic laws, baffle predictions, and mock depression.

Authoritative reports show that $2,500,000,000 will be spent on the 1922 building program, and each new settlement or expansion means extended feeders and enlarged trunk lines for electrical service.

It is now time to plan these expansions, and opportune to consider how to meet the call as economically as possible.

The function of Johns-Manville fibre conduit in any such work is so basic that it must be reckoned with in relation to labor, maintenance, and even finance. And here is its claim, now plainly proven by years of testimony—it is the most economical system per trench-mile-year.

By all means send for our fibre conduit booklet, which is replete with information on conduit installation in all its details. Sent from any Johns-Manville branch.

JOHNS-MANVILLE Inc.
Madison Avenue at 41st Street, New York City
Branches in 57 Large Cities
For Canada:
CANADIAN JOHNS-MANVILLE CO., Ltd., Toronto

JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

Through
ASBESTOS
and its allied products
Electrical Materials
Brake Linings
Insulations
Roofings
Packings
Cements
Fire Prevention Products

JOHNS-MANVILLE Fibre Conduit

LAST CALL

July 15th—The Last Day!

You must act quickly if you want your Power Plant Library at the special price of $14.50

THIS is the last chance you will ever have to get the POWER PLANT LIBRARY at $14.50. On July 15th the special offer which we have been making on the Library will be withdrawn for all time. Never again will we be able to make an offer like this—never again will you be able to get these great books at such a low price and on such easy terms.

Do you realize the importance of these things?

Do you know how to lay a boiler or engine foundation? Can you accurately figure the horsepower of boilers, and do you thoroughly understand the care and management of boilers, renewing tubes, etc.? Have you a working knowledge of combustion and proper firing? Can you figure heating surface?

Is your knowledge of shafting and belting complete? Are you familiar with line shafting, with the governors of different types of engines?

How about piping? Can you connect a boiler to a steam main? Do you know the difference between iron and steel piping? Can you estimate stock?

Pumps? Can you set up, operate, set the valves, figure the horsepower and make repairs on centrifugal, duplex and boiler feed pumps?

Can you set up the valves on all types of engines? Have you a thorough knowledge of valve gears, exhaust valves, slide valves, etc.?

Steam turbines? Do you understand the Curtis, the Allis-Chalmers and other types of turbines? Would you like a complete working knowledge of all operating details connected with turbines and auxiliaries?

The Power Plant Library supplies the answers to all these questions.

The Power Plant Library

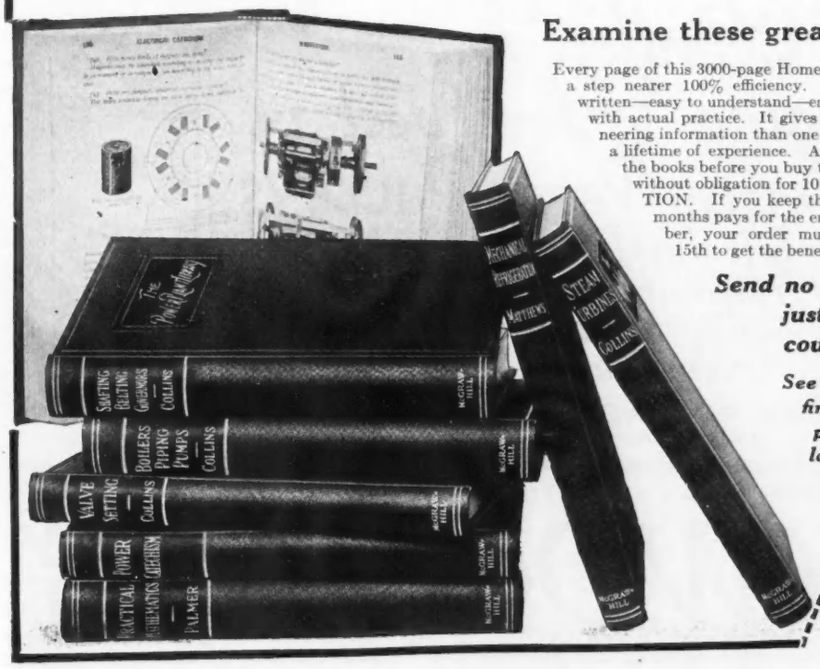
8 Handsome Volumes—3000 Pages—1200 Illustrations and Diagrams—over 2000 Questions and Answers—The Standard Work on Power Plant Practice

EVERY man who expects to become a top-notch power plant engineer needs the Power Plant Library. It is the one set on the market containing every item of information needed by the practical power-plant man, and yet within reason as to price and terms. The men who wrote these books get down to brass tacks. They tell you what you want to know in the way you want to know it. They give you in clear, understandable terms the right and wrong of power plant operation. Their aim throughout is to make you thoroughly familiar with every detail of power plant work—to give you a sound working knowledge of every type of plant—large and small. The Power Plant Library is arranged in such a way that it furnishes the beginner with a complete course of study on power plant work, and also supplies the trained engineer with a reference library that answers all of the problems that come up in his work.

The Sure Way To Bigger Pay

HOW can you earn more—how qualify for a bigger job with bigger pay? That's the question that's troubling you, isn't it? The one way—the sure way is through knowledge. The more you learn, the more you'll earn. The Power Plant Library gets down to facts—the facts that you need on the job every day. Mastery of these facts means quick promotion. There can be and is only one result from studying these books a few minutes each day—more money in your pocket.

The Power Plant Library covers the whole field—mathematics, engine running and repair, valve setting, boilers, pipes, pumps, shafting, belting, governors, turbines, refrigeration, electricity. Nothing is omitted. The solution of every problem has been worked out in advance for you, by practical engineers who have been through the mill.



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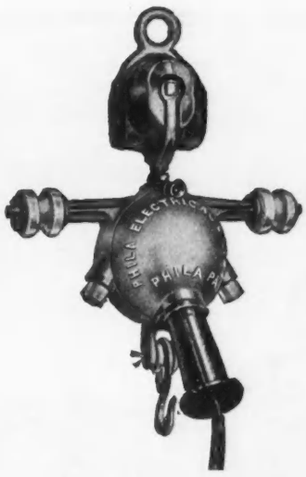

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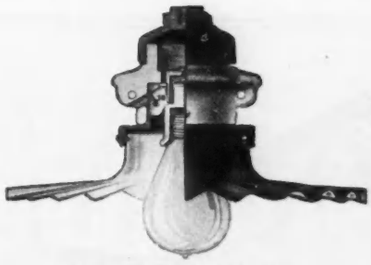

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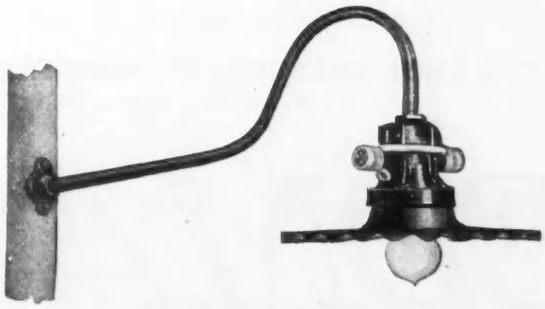

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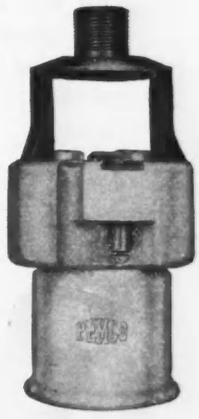

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REDMANOL Makes the Van Osdel Hair Cutter Easier to Use, and More Economical to Manufacture

The *REDMANOL* handle of the Van Osdel Electric Hair Cutter serves as the bearing for the driving shaft and is also the gear housing.

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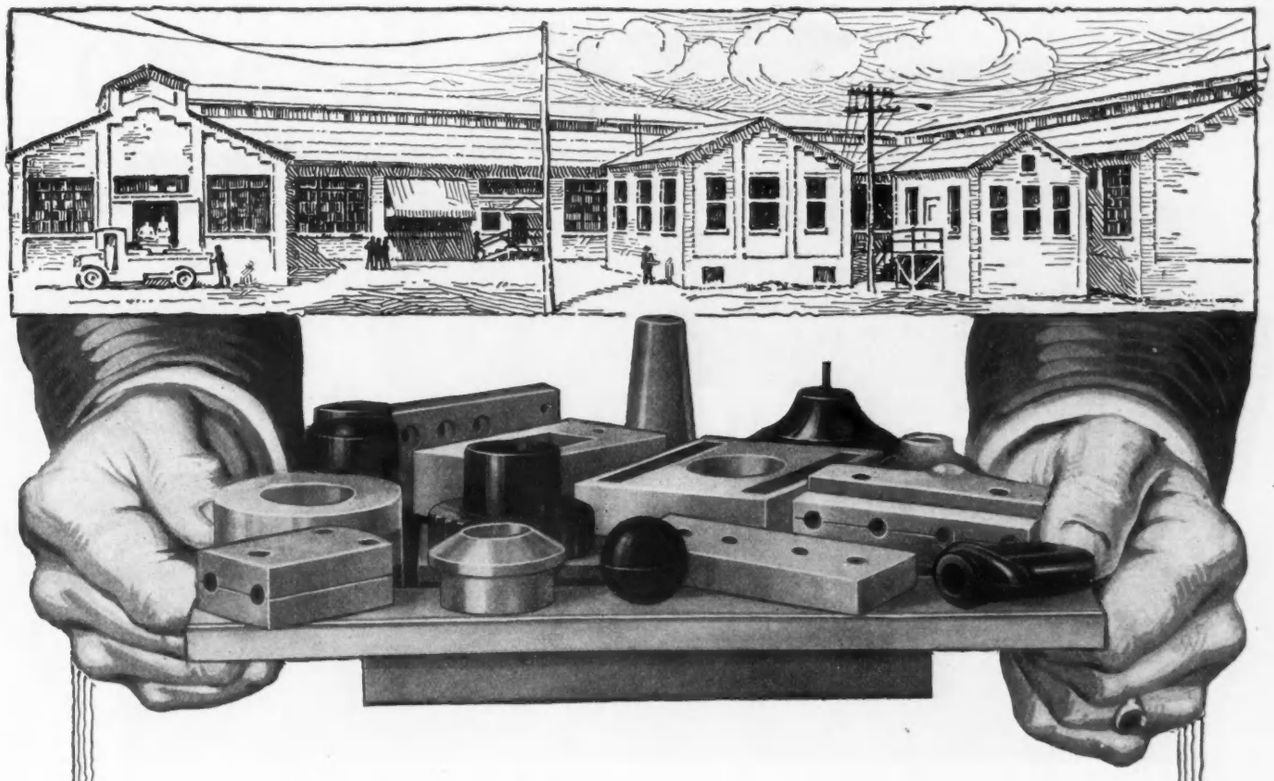

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and are making hundreds of other moulded specialties of every description, including those of the highest dielectric character.

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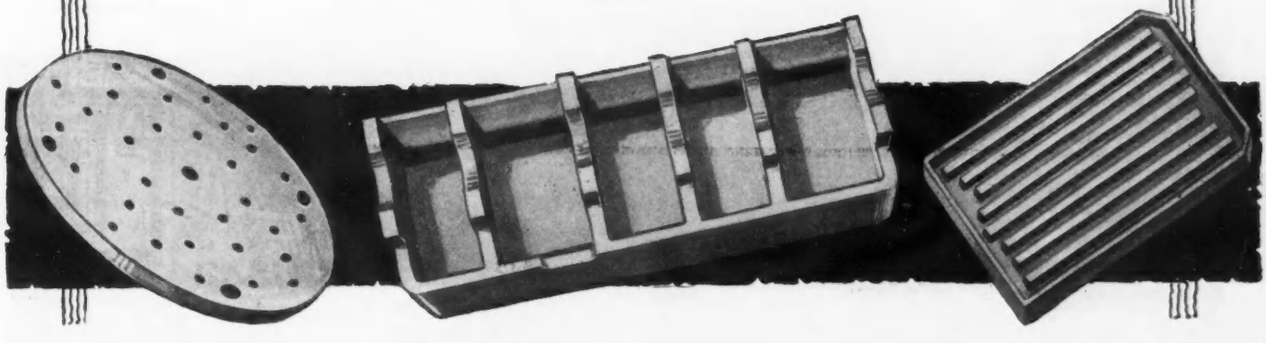

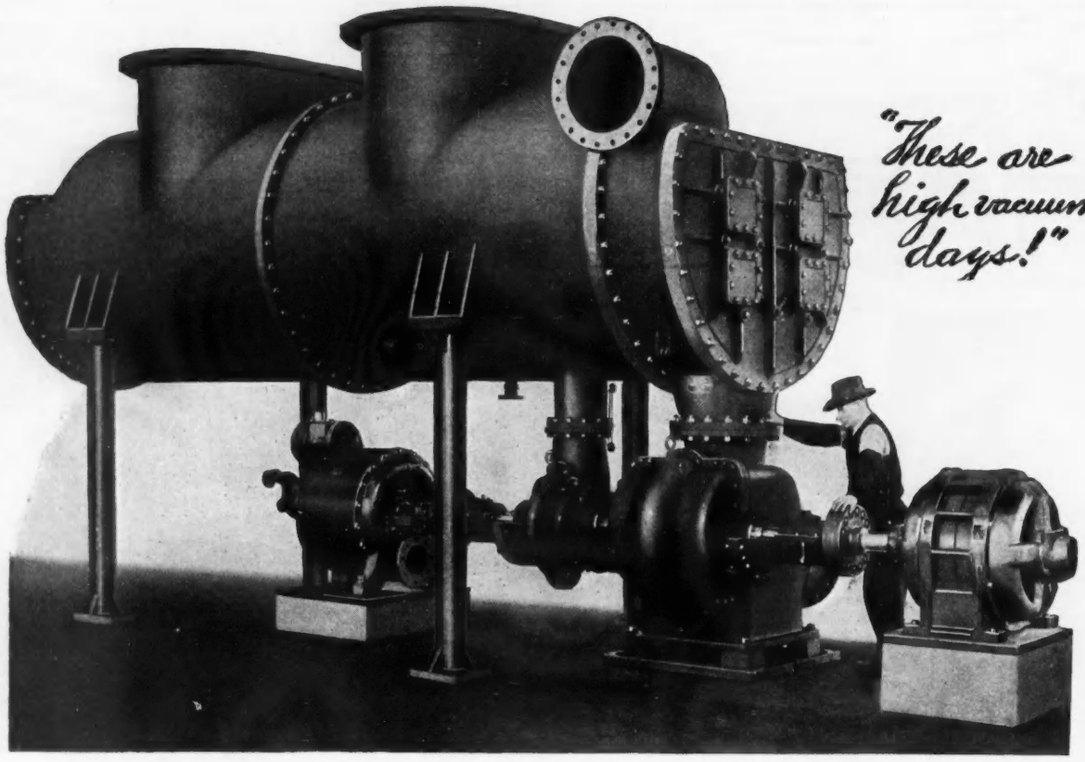

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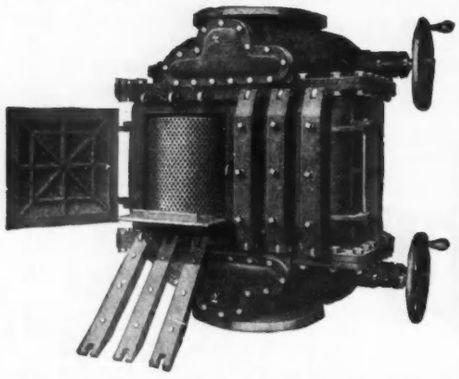
of Elliott-Ehrhart Surface Condensers



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C-240-A

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for ELECTRICAL APPARATUS

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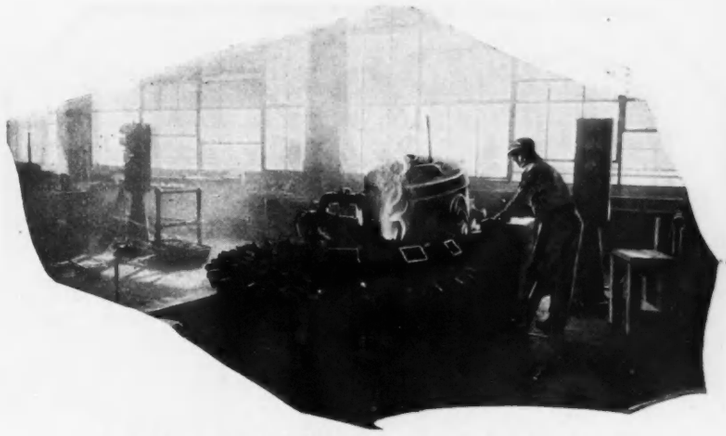

The electro magnetic stirring action in electric casting gives Chase Brass a fine smooth composition and accurate alloy.

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Wire
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Chase Tubes are made in an infinite number of sizes to meet every need of industry.

Large quantities of Chase Brass are consumed in the manufacture of electrical apparatus and supplies, and many of the most important power plants such as the new South Meadow Station use Chase Condenser Tubes.

Throughout the Chase Metal Works advanced methods of manufacturing prevail, that industry may be furnished with an ample supply of uniformly high grade brass. By laboratory analyses, tests and inspections at every step in the process—with immediate rejection of anything that does not measure up to highest standards—brass tubes, rods, wire and sheets of the finest quality are produced.

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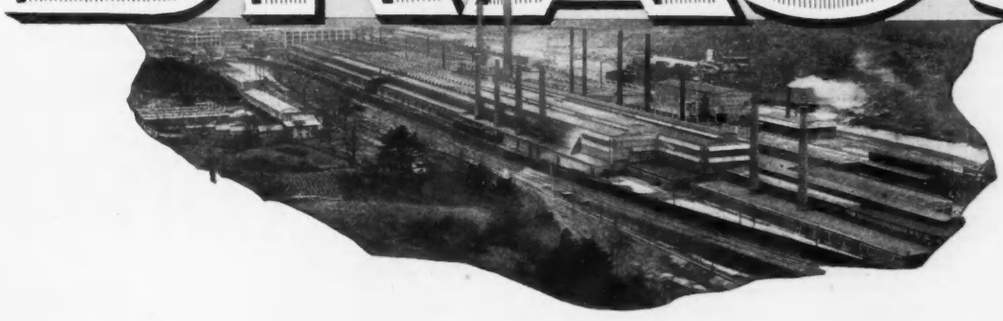
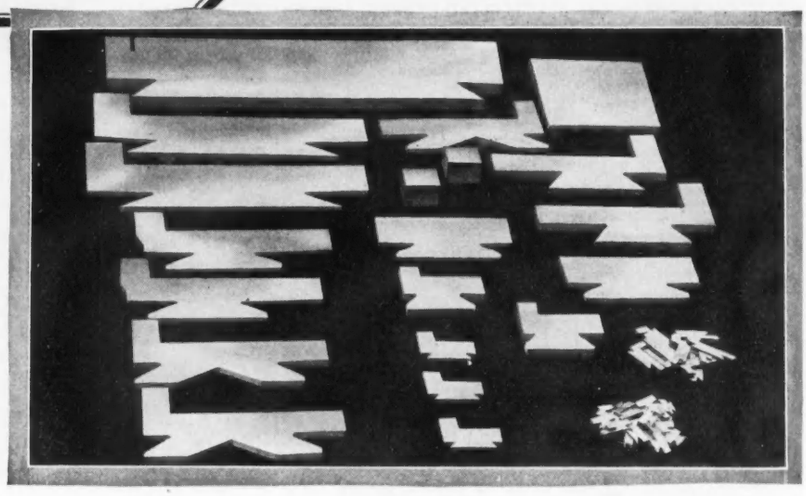


ROME Quality
BRASS & COPPER



Rome Quality Signifies Service

The idea behind their making, that of correct method and practiced care, is the fundamental reason why Rome Quality products give the satisfaction and service for which they are so widely known. Rome Quality is far more than a name—it is an obligation on the part of its makers to provide only brass and copper that measures to certain high standards of uniformity and quality, so that the prestige of the Rome name may be ever maintained.

Rome Quality commutator bars and segments are the selected equipment of many motor manufacturers, the country over. To them and their patrons Rome Quality bars and segments have long given evidence of their worth.

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ROME BRASS AND COPPER COMPANY ~ ROME, N.Y.

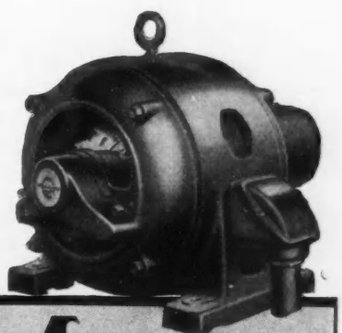
BRASS ROME COPPER

These features please motor users

Why shouldn't they? For each and every one of them is the result of a demand on the part of these same motor users.

For over ten years our men in the field have been gathering data on what motor users want and the Pow-R-full Motor supplies them all.

These features are just what you want in your motor. Bulletin 1294 describes and illustrates many important features of Wagner Pow-R-ful Motors. Ask for it.



Wagner Electric Manufacturing Company,
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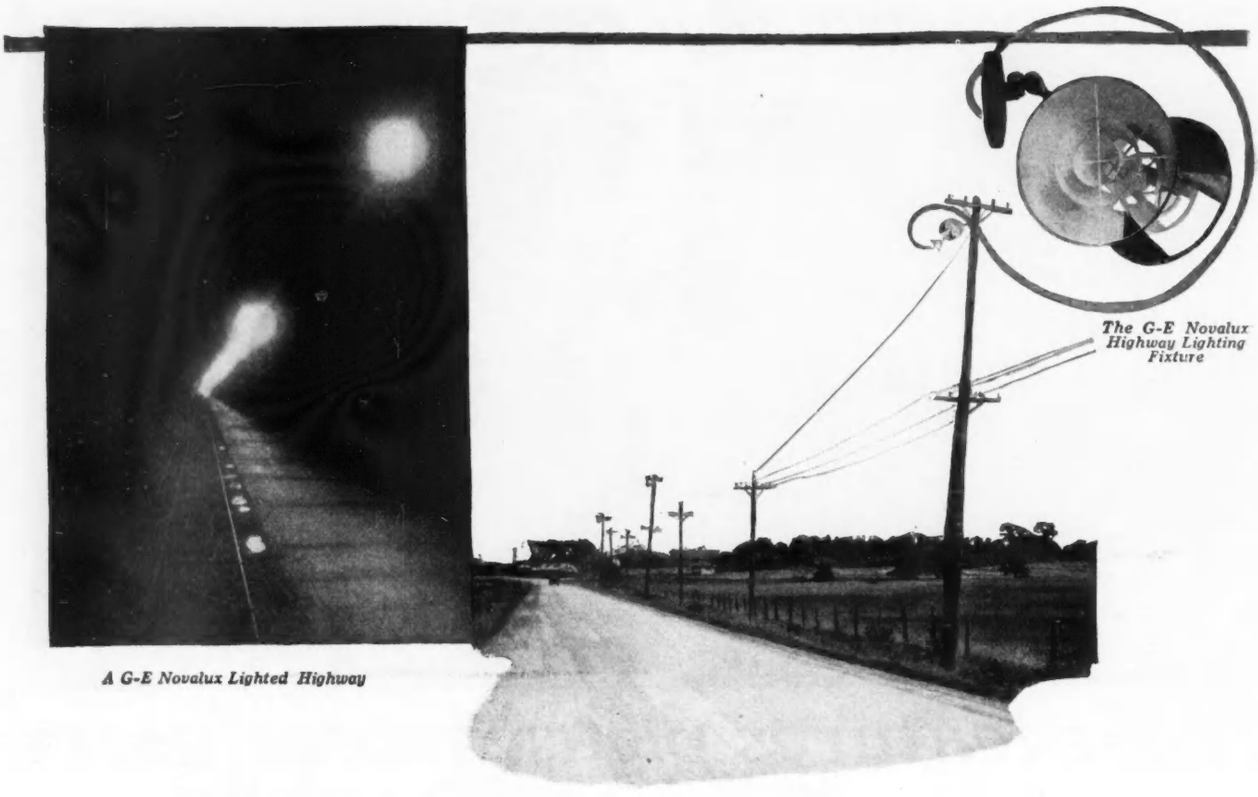
Wagner Quality **Pow-R-full Motor** *Polyphase*

The development of a rural load produces desirable business for central stations



The G-E Novalux Highway Lighting Fixture

A G-E Novalux Lighted Highway

Highway Lighting— the Missionary of Central Station Service

As a part of the good roads movement, highway illumination is engaging the attention of communities everywhere.

G-E Novalux Highway Units

offer an inexpensive and effective means for lighting rural roads, rendering them safer for traffic and pedestrians.

Highway lighting, wherever installed, serves as a constant advertisement of central station service to the farmers and others using the road. It also makes extension of lines easier as many farms along the lines of the highway can be served cheaply and easily.

G-E street lighting specialists will assist any central station in awakening local interest in highway lighting.

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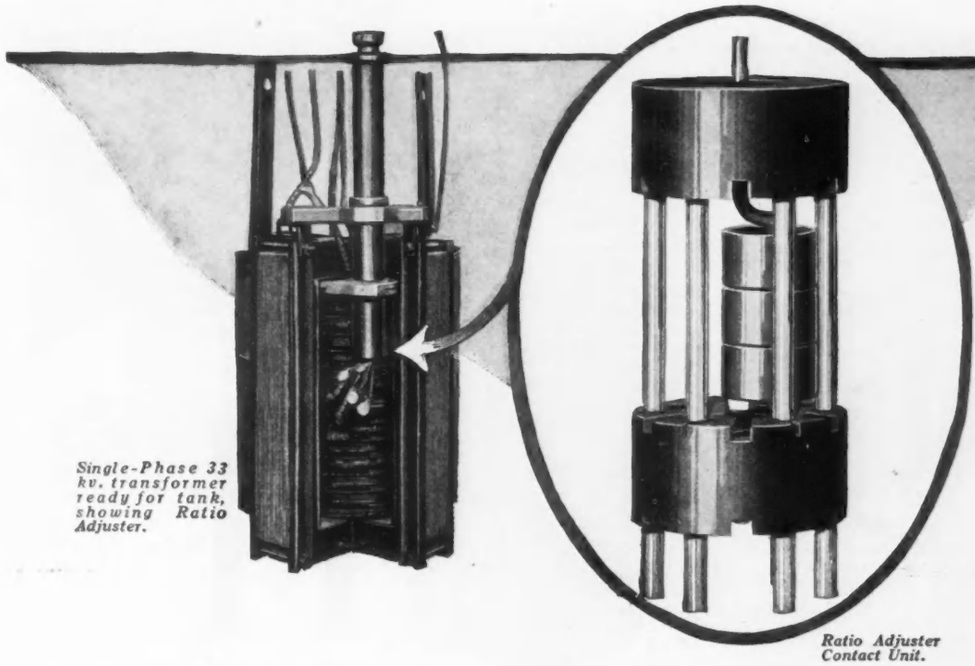
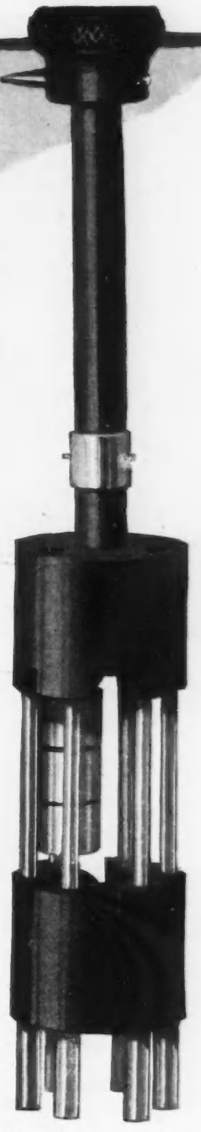
The Most Convenient Accessory Ever Added to a Transformer



Single-Phase 33 kv. transformer ready for tank, showing Ratio Adjuster.

Ratio Adjuster Contact Unit.



Ratio Adjuster Complete.

Transformer Ratio Adjuster

Just a fractional turn of the knob above the surface of the oil near a hand hole opening—and the adjustment is made.

The principal advantages are:

1. Ease and safety of changing taps.
2. No waits for better weather or transformers to cool.
3. No loose parts to be accidently dropped into the windings.
4. No contacts that can be left loose.
5. Contacts are thorough and *positive*.
6. No diagrammatic sketches to be unravelled with possibility of errors.
7. Error proof. No open or short circuits by failure to make right connections.
8. Elimination of complicated and live terminal boards.

The Ratio Adjuster is an exclusive and original G-E development. Its merit has been established by five years of excellent service records. It is designed for the maximum possible conditions of service, i. e., full circuit current of the transformer and full line voltage between the tap leads.

The Adjuster is regularly supplied on standard distribution and small power transformers, sizes 50 to 500 Kv-a. above 6000 volts and 10 to 500 Kv-a., 13,200 volts and higher.

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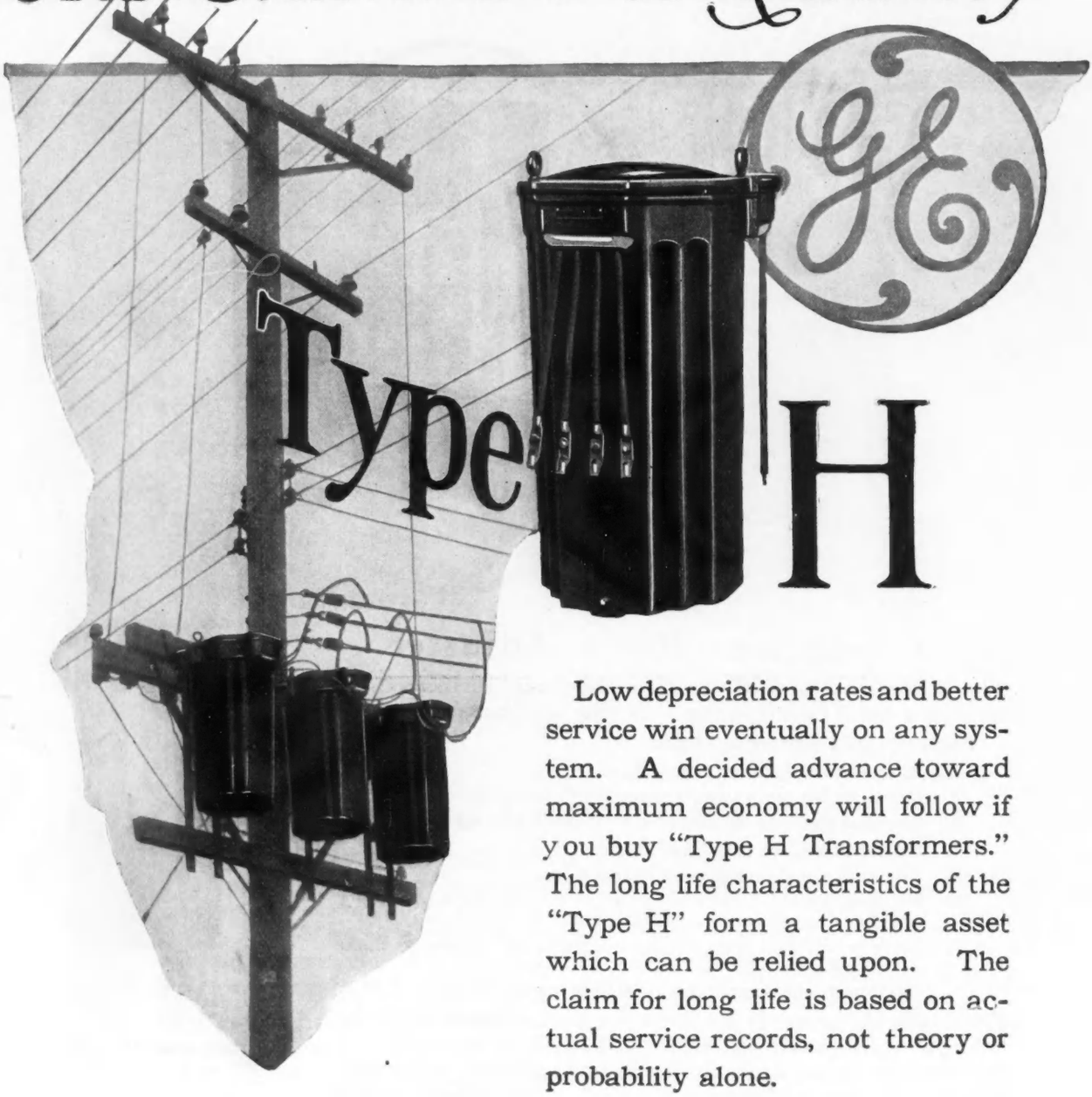
The Standard of Quality



Type H

Low depreciation rates and better service win eventually on any system. A decided advance toward maximum economy will follow if you buy "Type H Transformers." The long life characteristics of the "Type H" form a tangible asset which can be relied upon. The claim for long life is based on actual service records, not theory or probability alone.

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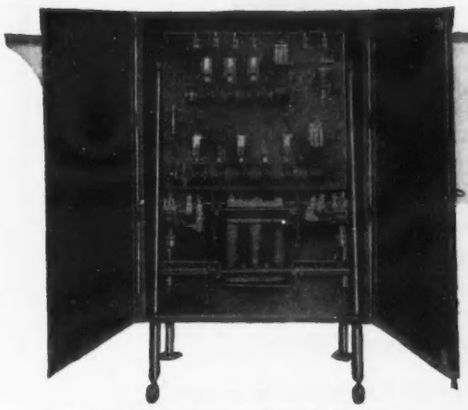
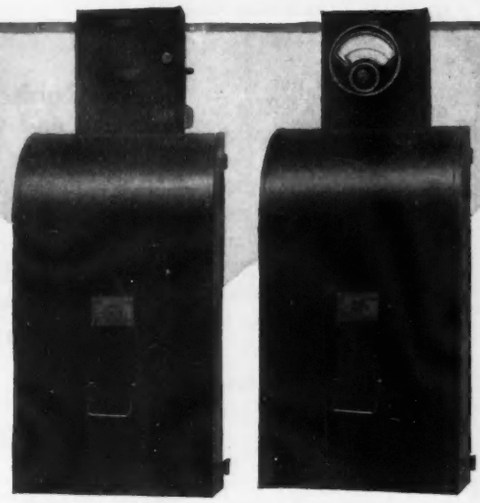
Automatic Starting Compensators for Squirrel Cage Induction Motors up to 600 Volts



G-E CR 7052 Automatic Starting Compensator—for floor mounting. For 3-phase 50- and 60-cycle motors 60 HP and larger, 220 V.; 125 HP and larger, 440 V.; 150 HP and larger, 550 V. For 3-phase 25-cycle motors 60 HP and larger, 220 V.; 100 HP and larger, 440 and 550 V. Minimum 2-phase ratings are somewhat different.



G-E Ammeter and Disconnecting Switch Attachments, and separable conduit wiring box of wall-type Compensator are designed with small knockout holes for convenient installation of either or both Attachments. These Attachments are for wall-type Compensctors only.

G-E CR 7052 Automatic Starting Compensator—for wallmounting. For 3-phase 50- and 60-cycle motors up to 50 HP, 220 V.; 100 HP, 440 V.; 125 HP, 550 V. For 3-phase 25-cycle motors up to 50 HP, 220 V.; 75 HP, 440 and 550 V. Maximum 2-phase ratings are somewhat different. Equipped with separable conduit wiring box designed to be used with or without Ammeter Attachment or Disconnecting Switch.

Thousands of G-E Automatic Starting Compensators are used today because of their incomparable performance—and their flexibility of application for Industry's needs.

Their construction is such that they can be installed easily, inspected readily, and operated with convenience and economy. Enclosing cases for all live parts provide safety for operators, and prevent tampering by others.

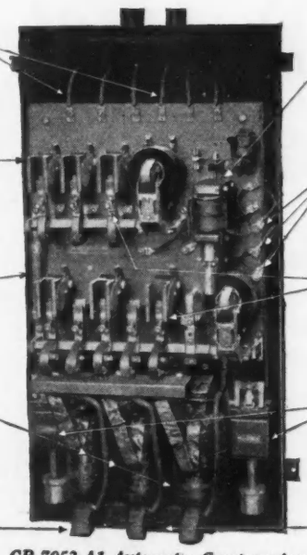
Terminals for motor and line leads. Liberal space for connections.

Contactors are suitable for severe service. They have solid copper tips, magnetic blowouts and moisture resisting coils, all accessible for easy inspection.

Fuse protects control circuit against accidental short-circuits when inspecting the equipment.

Three compensator coils for three phase give balanced starting conditions and maximum torque per ampere line current.

Accessible taps for selecting the most desirable starting voltage for any particular starting condition.



CR 7052-A1 Automatic Compensator with cover removed

Current limit relay automatically opens starting contactor and closes running contactor immediatly upon proper acceleration of the motor.

Terminals for control leads. Liberal space for running wires along edge of base to conduit wiring box.

Starting and running contactors open all lines to three-phase or two-phase three-wire motors.

Two inverse-time overload relays.

Padlock may be attached here to lock cover on.

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KERITE remains long after the price is forgotten.

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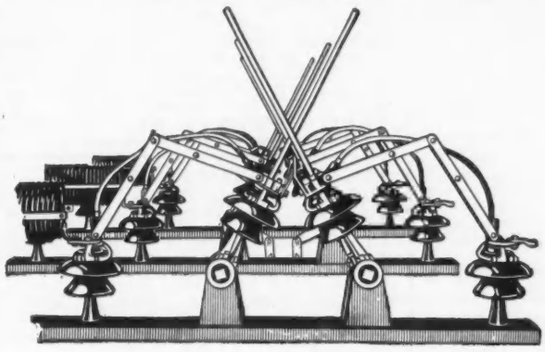
The Famous Elpeco Pole Top Switch— The Guardian of the High Tension



Elpeco
Pole Top Switch

FEW Central Station men would want to answer this question:—

"What would it cost you to open the circuit on your high tension lines?"

The picture they see of wrecked apparatus from this operation does not look pretty, translated into replacement costs.

On this basis of protection the Elpeco Pole Top Switch has in some instances saved its cost one hundred times during the course of a single year.

The Elpeco Pole Top Switch opens the circuit positively with no destructive effect upon the system. It breaks all phases simultaneously. It applies ample pressure at the point of contact, with the smallest stress at the insulator.

Operates equally well under all weather conditions. Cannot be frozen shut. Opening under icy conditions does not affect contact upon closing again.

Every switch receives test before shipping.

The Elpeco Pole Top Switch is built to meet hard operating conditions—not to meet a price. It weighs practically twice as much as other switches of the same capacity and voltage.

Elpeco's specialized knowledge on high tension apparatus and installations is available to Engineers, Contractors and Operating Executives.

We solicit your correspondence.

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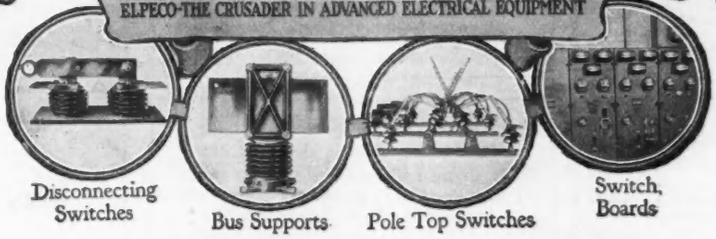
Protection in the future from DANGER and LOSSES

ELPECO-THE CRUSADER IN ADVANCED ELECTRICAL EQUIPMENT



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-Phase, 60-Cycle, A. C. Generators

Kva.			Speed
1	30	Fairbanks-Morse revolving field, 2300-volt	1200
1	50	Westinghouse, type G, revolving field, 2300-volt	1200
1	50	Ft. Wayne, revolving field (can be used for direct-connection) 220 or 440 v.	300
1	50	Gen. Elec., type TRE, form D, rev. field, 240 or 480-volt, to New York Safety, horizontal, self-oiling center crank steam engine	300
1	55	Westinghouse, type G, revolving field, 220 or 440 volt	1200
1	55	Westinghouse, rev. field, 2200-volt to McEwen, horizontal, tandem comp. automatic, self-oiling steam engine	257
	60	Electric Machinery, rev. field, 2300-volt	700
1	70	Westinghouse, rev. field, 2400-v. to Harrisburg-Fleming horizontal, self-oiling, side-crank, auto. steam engine	300
1	75	Ridgeway, revolving field 220-volt to Ridgeway horizontal, self-oiling, automatic steam engine	300
1	75	Crocker-Wheeler 2- rev. field, 2300-volt to McEwen, horizontal, center-crank, self-oiling auto., steam engine	275
1	90	Allis-Chal., rev. field, 2300-volt	1200
1	150	Gen. Elec., type ATB, form PB, rev. field, 220 or 440-volt, 3-phase	900
1	150	Crocker-Wheeler, revolving field, 2300-volt to Harrisburg-Fleming, 4-valve, self-oiling, automatic steam engine	257
1	625	Westinghouse, rev. field, 2300-volt, 3-phase, turbo-generator, direct-connected to Westinghouse-Parsons, horizontal, 3-stage, steam turbine	3600
1	625	Allis-Chalmers revolving field, 3-phase, 2300-v., D.C. to Parsons horizontal, 3-stage steam turbine	

3-Phase, 60-Cycle, A. C. Generators

Kw.			Speed
5	3	Gen. Elec., RC, interpole (50°), new	2200
1	6	Northern	600
1	7½	Sturtevant, MP	11 0
1	10	Fairbanks-Morse	1500
1	13	Crocker-Wheeler	900
1	15	Crocker-Wheeler	1350
1	15	Westinghouse, type S	675
1	20	Holtzer-Cabot	1250
1	25	Ft. Wayne	875
1	25	Northern, 125-250-volt, 3-wire, with balance coil	750
1	25	Milwaukee to 9 ½ x 10 in. Erie-Ball auto., center-crank, self-oiling steam engine	340
1	30	Western Elec.	1250
1	30	Ft. Wayne	750
1	30	Westinghouse, type S	725
1	40	Gen. Elec., 125-250-volt, 3-wire, to Harrisburg-Fleming, steam engine	360
1	45	Westinghouse, type M	525
1	50	Gen. Elec., type DLC, interpole	1150
1	75	Westinghouse, type M	750
1	100	Triumph	700
1	100	Elec. Machinery, 6-pole	350
1	150	Gen. Elec., MP, type C-4, compound, to Curtis form E, non-condensing steam turbine	2000

250-volt, D. C. Generators

Kw.			Speed
1	125	Gen. Elec., 6-pole, form L3, comp., to Ball-wood, tandem compound, self-oiling, automatic steam engine	250

110-Volt, D. C. Generators

Kw.			Speed
1	2¾	Allis-Chal., type K	1300
5	3	G. E., type RC, interpole (50°)	2300
1	3	Roth, interpole	1950
2	3	Imperial interpole	1800
1	3	Westghse., SK, interpole	1500
2	3	G. E., CVC, interpole	1450
5	5	Imperial, interpole, new	1200
3	5	Westinghouse, type SK, interpole (50°), new	700
1	5¾	Crocker-Wheeler	1550
1	6	Westghse., type SK, int'p	1480
1	6	Northern	1200
1	6	Card	1150
1	6½	Crocker-Wheeler	1100
3	6½	Gen. Elec.	950
1	7	G. E., type CVC, int'pole	1800
1	20	Western Elec.	675
1	25	Westinghouse	975
1	25	Gen. Elec., new, to 9 x 7 in. Gen. Elec., vertical, marine new steam engine	400
1	30	Triumph	950
1	30	Westinghouse, type S	850
1	30	Crocker-Wheeler	825
1	35	G.E.-Curtis steam turbine	3600
1	35	Triumph, MP	575
1	35	Western Elec. to Chuse horizontal steam engine	325
1	45	Westinghouse	550
1	50	Willey	800
1	50	Western Electric	260
1	55	Westingh ouse	850
1	67½	Sprague, 6-pole	875
1	75	C. & C., 6-pole, comp., direct con. to Ames, center-crank, automatic steam engine	275
1	75	National	750

110 -Volt, D. C. Generators

Kw.			Speed
1	75	Western Electric direct connected to Ball horiz., self-oiling steam engine	250
1	85	Westghse., MP, type S	725
1	125	Triumph, 6-pole	600

220-Volt, D. C. Motors—C

Hp.			Speed
1	3½	Roth	1575
1	3¾	G. E., type RC, interpole	800
1	3¾	G. E., type CQ	750
1	3¾	Browning	675
1	4	Crocker-Wheeler, form L	1300
1	4	G. E., type RLC, interpole, var. speed	500-1500
1	4	Allis-Chalmers, type N	575
1	4	Watson	450
1	5	Westghse., SK, interpole	1800
2	5	G. E., CVC, interpole	1575
1	5	Westinghouse, type M	1300
1	5	Peerless	1275
1	5	G. E., type CQ	1175
2	5	Crocker-Wheeler, form F	980
1	5	Crocker-Wheeler, form E	950
1	5	Westinghouse, type M	925
1	5	Sprague-Lundell, RT	680
1	5	G. E., type CE	675
8	5	Gen. Elec., type RF, shunt, interpole, adjustable speed	450-1350
1	6	Westinghouse, type S	1465
1	6½	Crocker-Wheeler, form F	1150
1	7½	G. E., RC, interpole	1575
1	7½	Western Elec., type E	1475
1	7½	G. E., CVC, comp., int'p.	1300
2	7½	Allis-Chalmers, type K	875
4	7½	G. E., CE	875
1	7½	Crocker-Wheeler, form I	875
1	7½	Gen. Elec., CQ	825
2	7½	Northern, MP	800
1	7½	Sturtevant, comp., interpole, var. speed	545-1090
1	10	Westinghouse, type S	1325
2	10	Sprague (G. E.), comp., interpole	1000
1	10	Browning	850
1	10	Crocker-Wheeler	800
2	10	G. E., MP, CE	700
1	12½	Ft. Wayne, shunt, interpole, variable speed	400-800
3	15	Northern	1200
1	15	G. E., CQ	625
1	15	Westinghouse, type S, comp	560
1	20	Crocker-Wheeler, comp.	775
1	20	Gen. Elec., DLC, int-pole	600
1	20	Northern, var. speed	400-1000
1	25	Fairbanks-Morse	950
1	25	Crocker-Wheeler	750
2	25	G. E., 6-pole, type CL	635
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1	250	450	G. E., M
2	250	600	G. E., M
2	200	900	G. E., L
1	160	900	G. E., syn.*
1	125	600	G. E., form M
1	100	600	Westg., F, sl. rg.
2	100	720	G. E., K
1	75	900	Allis-Chal., ANY
1	75	900	G. E., K
2	75	720	G. E., K
1	75	450	G. E., M*
1	60	300	West., CW
3	50	900	Cr.-Wh. & G. E.
2	35	900	G. E., sq. cage
1	30	900	Westg., MS
1	20	1800	Westg., CW
1	25	1200	West., CS
1	25	1200	G. E. K.
1	25	900	Cr.-Wh.
1	25	600	G. E.
1	5	1800	West., A

2-Phase Motors on request

D.C. Motors, 230-Volt

No.	Hp.	Rpm.	Make
1	300	500	G. E.
1	100	800	G. E.
4	50	1250	Allis-Chal.
1	50	700	West.
1	35	875	West.
1	25	1300	Sprague
4	25	600/1200	Allis-Chal.

D.C. Motors, 230-Volt (Continued)

No.	Hp.	Rpm.	Make
1	15	1250	Allis-Chal.
1	10	1200	Allis-Chal.
5	10	275/1575	Allis-Chal.

D.C. Motors, 125-Volt

3	20	650	Allis-Chal.
1	15	775	SK. West.
2	7½	1100	G. E.
1	5	700	Diehl
3	3	1100	G. E.
2	3	1700	G. E.

A. C. Generators, 440 and 2300-Volt

No.	Kw.	Rpm.	Make
1	200	720	G. E., form B
1	130	900	G. E., form PB
1	100	900	Cr.-Wh.
2	30	1200	West.

D.C. Generators, 250-Volt

1	200	575	G. E.
1	100	900	G. E.
1	100	675	G. E.
1	75	575	G. E.
1	50	600	West.
1	30	1000	West.
2	15	900	Allis-Chal.

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1—625-kva., 3600 r.p.m., 220/440-v., 60-cy. Gen. Elec. condensing bleeder type with direct connected exciter, excellent condition.

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1—200-kw., 125/250-v., Gen. Elec. 3-wire, 200-rev. gen., 15 and 26 x 17 McIntosh & Seymour tand. cpd. engine.

1—200-kw., 250-v., Gen. connected to Allis-Chal., 18 x 36 right-hand Corliss Engine.

1—150-kva., Cr.-Wh., 220/440-v., 3-ph., 60-cy. Skinner tand. cpd. engine set.

1—100-kw., 125- or 250-v., 2-wire, D.C. Westinghouse, R.H. gen. conn. to Harrisburg std. tand. cpd., 11 x 18 x 13 engine, 275 r.p.m., complete.

1—50-kw., 125-v. Westghse., R.H., gen. connected to Harrisburg 13 x 12 std. engine, 300 r.p.m., complete with swbd. and steam separator.

Motor Generator Sets

300-kw., 720-rev., 125/250-v., 3-unit set consisting of (2) 150-kw., 125-v., D.C., G. E. gen. (1) 450-hp., 440/2300-v. motor.

200-kw., 600-rev., 250-v., Gen. Elec Gen., 350-hp., 440/2300-v. syn.

125-kw., 600-rev., 125/250-v. West. Gen., 190-hp., 220/440-v. motor.

100-kw., 250-v. Gen. Elec. Gen., 150-hp., 900-rev., 440/2200-v. syn.

1—50-kw., 1200 r.p.m., 125-v., Cr.-Wh. with 75-hp., 220/440-v. motor.

50-kw., 720-rev., 250-v. West. Gen., 75-hp., 220/440-v. motor.

10-20-25-40-kw., 125-v. Exciter Sets.

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60-CYCLE, A.C. MOTORS

Stk. No.	*Hp.*	*Volts*	*Speed*	*Ph.*	*Cy.*	*Make and Type*
608	500	2200	600	3	60	G. E., "M", slip ring, 3-bearing
2131	425	440/220	600	3	60	Westghse., synchronous, 3-bearing
Cons.	400	440	450	3	60	Westghse., "CW", slip ring, 2-bearing
763	300	440/220	600	3	60	G. E., "M", slip ring, 3-bearing
796	300	2200	720	3	60	G. E., "K", sq. cage, 2-bearing
1022	250	440/220	900	3	60	G. E., "M", slip ring, 2-bearing
289	250	2200	600	3	60	G. E., "K", sq. cage, 2-bearing
Cons.	250	2200	900	3	60	Westghse., slip ring, "CW", 3-bearing
Cons.	250	550	900	3	60	Westghse., slip ring, "CW" 3-bearing
992	200	2200	600	3	60	G. E., "K", sq. cage, 2-bearing
9401	150	440/220	690	3	60	Westghse., "HF", slip ring, inter. duty
1501	150	440/220	690	3	60	Westghse., "HF", slip ring, inter. duty
5501	150	440/220	720	3	60	G. E., "M", slip ring
4501	125	440/220	720	3	60	Westghse., "HF", slip ring
1045	100	550	700	3	60	G. E., "L", wound rotor
5401	100	440/220	720	3	60	G. E., "M", slip ring
1049	100	550	720	3	60	Westghse., "HF", slip ring
1051	100	440/220	720	3	60	Westghse., "HF", slip ring
1052	100	440/220	720	2	60	Westghse., "HF", slip ring
1053	100	2200	720	3	60	Westghse., "HF", slip ring
1054	100	2200	720	2	60	Westghse., "CW", slip ring
5921	100	440/220	600	3	60	G. E., "K", sq. cage
1055	100	550	720	3	60	G. E., "M", slip ring
1231	82	440/220	485	3	60	G. E., "ITC", inter. duty
1232	82	440/220	514	3	60	G. E., "ITC", inter. duty
2401	75	440/220	1200	3	60	Allis-Chal., synchronous
1295	75	440/220	600	3	60	G. E., "K", sq. cage
3121	75	440/220	514	3	60	G. E., "M", slip ring
2321	75	440/220	514	3	60	G. E., "M", slip ring
1233	75	440/220	580	3	60	G. E., "ITC", inter. duty
1234	75	440/220	580	3	60	G. E., "ITC", inter. duty
3321	60	440/220	600	3	60	G. E., "M", slip ring
4321	60	440/220	600	3	60	G. E., "M", slip ring
6321	60	440/220	600	3	60	G. E., "M", slip ring
6321	60	440/220	600	3	60	G. E., "M", slip ring
8821	50	440/220	600	3	60	G. E., "M", slip ring
1271	37	440/220	3600	3	60	G. E., "KT", sq. cage (new)
1306	37	440/220	3600	3	60	G. E., "KT", sq. cage
1221	25	440/220	1200	3	60	Allis-Chal., slip ring
826	25	440/220	1200	3	60	Westghse., "CCL", sq. cage
828	25	440/220	600	3	60	G. E., "KT", sq. cage
1248	22	440/220	900	3	60	G. E., "ITC", inter. duty
1239	22	440/220	1200	3	60	G. E., "ITC", inter. duty
953	20	220	900	3	60	Westghse., "CS", sq. cage
9443	20	440/220	1200	3	60	G. E., "M", slip ring
1299	15	440/220	1800	3	60	G. E., "KT", sq. cage (vertical)
831	15	440/220	900	3	60	G. E., "L", wound rotor
8421	15	440/220	900	3	60	G. E., "MT", slip ring
1298	15	440/220	900	3	60	G. E., "KT", sq. cage
1025	10	220	1200	2	60	Allis-Chal., sq. cage
1252	10	440/220	1200	3	60	G. E., "KT", sq. cage
1273	10	440/220	1200	3	60	G. E., "KT", sq. cage
3721	10	220	1200	2	60	G. E., "KT", sq. cage
1253	10	440/220	1200	3	60	G. E., "MT", slip ring
1272	10	440/220	900	3	60	G. E., "KT", sq. cage
1254	7½	440/220	900	3	60	G. E., "KT", sq. cage
1275	7½	440/220	1200	3	60	G. E., "KT", sq. cage
6721	7½	220	1200	2	60	G. E., "KT", sq. cage
5521	7½	440	1200	2	60	G. E., "KT", sq. cage
(5)	6	440	1800	3	60	G. E., "KT", sq. cage (mult. speed) 600/900/1200/1800
(2)	5	440/220	1200	3	60	G. E., "KT", sq. cage
(3)	5	440/220	1800	3	60	Westghse., sq. cage
(1)	5	440/220	1800	3	60	G. E., "MT", slip ring
(1)	5	440/220	900	3	60	G. E., "KT", sq. cage

The above is a partial list; quotations covering other machines upon request.

25-CYCLE A.C. MOTORS

Stk. No.	*Hp.*	*Volts*	*Speed*	*Ph.*	*Cy.*	*Make and Type*
806	300	440	500	3	25	G. E., "M", slip ring, 3-brg.
1226	200	440/220	500	3	25	G. E., "M", slip ring, 3-brg.
1354	57	440/220	750	3	25	Westghse., sq. cage
1317	50	440/220	750	3	25	G. E., "K", sq. cage
1333	50	440/220	750	3	25	G. E., "K", sq. cage
1356	50	440/220	750	3	25	Allis-Chal., sq. cage
822	40	440/220	750	3	25	Burke, sq. cage
1320	37	440/220	750	3	25	G. E., "ITC", inter. duty
1321	37	440/220	750	3	25	G. E., "ITC", inter. duty
1322	37	440/220	750	3	25	G. E., "ITC", inter. duty
1350	37	440/220	750	3	25	G. E., "ITC", inter. duty
1331	35	440/220	1500	3	25	Westghse., sq. cage
1342	35	440/220	750	3	25	G. E., "K", sq. cage
1353	35	440/220	750	3	25	G. E., "K" sq. cage
1238	32	440/220	750	3	25	G. E. "ITC" Inter. duty
1338	32	440/220	750	3	25	G. E "K" sq. cage
1349	30	440/220	750	3	25	G. E., "K", sq. cage
1231	30	440/220	750	3	25	G. E., "M", sl. ring
1357	25	440/220	750	3	25	Westghse., slip ring
1324	22	440/220	750	3	25	G. E., "ITC", inter. duty
1325	22	440/220	750	3	25	G. E., "ITC", inter. duty
6231	20	440/220	750	3	25	G. E., "M", slip ring
7231	20	440/220	750	3	25	G. E., "M", slip ring
8231	20	440/220	750	3	25	G. E., "M", slip ring
9231	20	440/220	750	3	25	G. E., "M", slip ring
1344	20	440/220	750	3	25	Westghse., sq. cage
0331	20	440/220	750	3	25	G. E., "M", slip ring
1451	20	440/220	750	3	25	Westghse., "CX", sq. cage
1345	15	440/220	750	3	25	G. E., "KT", sq. cage
1240	10	440/220	750	3	25	G. E., "MT", slip ring

25-CYCLE A. C. MOTORS (Continued

Stk. No.	*Hp.*	*Volts*	*Speed*	*Ph.*	*Cy.*	*Make and Type*
835	10	440/220	750	3	25	Burke, "EM", sq. cage
1315	10	440/220	750	3	25	Westghse., sq. cage
1339	10	440/220	750	3	25	G. E., "KT", sq. cage
1340	10	440/220	750	3	25	Westghse., sq. cage
1352	10	440/220	750	3	25	G. E., "KT", sq. cage
1358	10	440/220	750	3	25	Allis.-Chal, sq. cage
1337	7½	440/220	750	3	25	G. E., "KT", sq. cage
1341	7½	440/220	750	3	25	G. E., "KT", sq. cage
1359	7½	440/220	750	3	25	G. E., "KT", sq. cage
836	7½	440/220	750	3	25	Burke, "EM", sq. cage
(3)	5	440/220	1500	3	25	G. E., "KT", sq. cage
(4)	5	440/220	750	3	25	Burke, "EM", sq. cage
(1)	5	440/220	500	3	25	G. E., "KT", sq. cage
(2)	2	440/220	750	3	25	G. E., "KT", sq. cage
(3)	1	440/220	750	3	25	G. E., "KT", sq. cage
(2)	1	440/220	1500	3	25	G. E., "KT", sq. cage

The above is a partial list; quotations covering other machines upon request.

D. C. MOTORS

Stk. No.	*Kw.*	*Volts*	*Speed*	*Make and Type*
1360	500	230	440	G. E. (Spr.) "C", interpole, 3-brg.
1361	500	230	440	G. E. (Spr.) "C", interpole, 3-brg.
1631	250	115	210	G. E. (Spr.) "C", interpole, 3-brg.
0630	230	115	210/420	G. E. (Spr.) "C", interpole, 3-brg.
909	200	500	430	G. E., "CLB", 2-bearing
4909	185	230	415	G. E., "CLB", 2-bearing
2221	150	230	550	G. E., "DLC", interpole
1222	125	230	560	G. E., "DLC", interpole
2631	75	115	600	G. E. (Spr.), "C", interpole
209	60	115	650	G. E., "DLC", interpole
1362	60	115	500/700	G. E. (Spr.), "C", interpole
902	50	115	650	G. E., "DLC", interpole
2211	40	230	725	G. E. (Spr.), "LC", interpole
952	35	500	650	G. E., "CLB"
1122	30	230	725	G. E. (Spr.), "LC", interpole
1123	30	230	725	G. E. (Spr.), "LC", interpole
1124	30	230	725/1000	G. E. (Spr.), "LC", interpole
1011	30	230	1200	G. E. (Spr.), "LC", interpole
1289	30	115	600/720	G. E. (Spr.), "LC", interpole
1217	25	230	250/1000	Westghse., "SK" interpole rev. duty (new)
1218	25	230	250/1000	Westghse. "SK" interpole rev. duty (new)
1125	25	230	750/1000	G. E. (Spr.), "LC" interpole
1126	20	230	1150	G. E., "RC", interpole
1127	20	230	1150	G. E., "RC" interpole
1128	20	230	1150	G. E., "RC" interpole
1129	20	230	1150	G. E., "RC" interpole
1130	15	230	850	G. E., "RC" interpole
1131	15	230	800	G. E., "RC" interpole
975	7½	115	825	G. E., "CQ"
978	7½	115	825	G. E. "CVC" interpole
(2)	5	230	975	G. E., "RC", interpole
(1)	5	230	1100	Crocker-Wheeler, "CM"
(2)	5	230	1700	G. E., "RC", interpole
(2)	3	230	1700	R. & M., interpole
(2)	3	230	1150	G. E., "RC" interpole
(5)	2	230	1100	G. E., "RC", interpole
(2)	1	230	2550	R. & M.
(6)	1	230	1700	G. E., "RC", interpole

The above is a partial list; quotations covering other machines upon request.

D. C. GENERATORS

Stk. No.	*Kw.*	*Volts*	*Speed*	*Make and Type*
9630	375	250	500	G. E., Spr., "C", interpole, 3-bearing
8631	200	125	230	G. E., Spr., "C" interpole, 3-bearing
909	150	550	500	G. E., "CLB", 2-bearing
9094	150	250	485	G. E., "CLB", 2-bearing
9023	125	250	650	G. E., "DLC", interpole
7023	100	250	625	G. E., "DLC", interpole
7631	60	125	650	G. E. (Spr.), "C", interpole
2902	40	125	750	G. E., "DLC", interpole
839	30	550	750	G. E., "CLB"
2211	30	250	850	G. E., (Spr.), "LC", interpole
7122	25	250	825	G. E. (Spr.), "LC", interpole
6211	17½	230	1150	G E., "RC", interpole
9211	15	230	1150	G. E., "RC", interpole
1311	12½	250	950	G. E., "RC", interpole
2311	10	250	975	G. E., "RC" interpole
7979	7½	125	950	G. E., "RC", interpole
879	5	125	950	G. E., "RC", interpole

The above is a partial list; quotations covering other machines upon request.

ROTARY CONVERTERS

1—330-kw., practically new, 275-volt, 1200-r.p.m., compound wound General Electric, type HCC, each complete with three 110-kw., 2200-volt primary, single phase, 60-cycle transformers (for 3-phase operation). This unit with or without complete switchboard equipment.

MOTOR-GENERATOR SETS

(Each complete with starter, rheostat, etc.)

Gen. 300-kw., 250-volt, 720-r.p.m. Gen.Elec., comp. wd.
Motor, 450-hp., 2300-volt, 700-r.p.m., 3-ph., 60-cy. Gen. Elec., sq. cage
Gen. 200-kw., 125-volt, 600-r.p.m. Westghse., compound wound, 6-pole
Motor, 300-hp., 2300-volt, 600-r.p.m., 3-ph., 60-cy. Westchse. synchronous
Gen. 185-kw., 550-volt, 600-r.p.m. Gen. Elec. "CLB", 6-pole
Motor, 300-hp., 2300-volt, 600-r.p.m., 3-ph., 60-cy. Gen. Elec., "ATI" syn.
Gen. 100-kw., 1200-r.p.m., 250-volt, 6-pole, "RC" Gen. Elec.
Motor, 150-hp., 1200-r.p.m., 440/220-volt, 3-ph., 60-cy. Gen. Elec., sq. c. KT
Gen. 50-kw., 250-volt, 900-r.p.m., comp. wd. "RC" Gen.Elec.
Motor, 75-hp., 440-volt, 900-r.p.m. Gen. Elec., 3-ph., 60-cy. "KT"
Gen. 50-kw., 125-volt, 900-r.p.m., comp. wd. Gen. Elec., "DLC"
Motor, 75-hp., 440/220-volt, 900-r.p.m., 3-ph., 60-cy. Gen. Elec. "KT"
Gen. 40-kw., 250-volt, 700-r.p.m. Westghse., type "CLB"
Motor 60-hp., 440/220-volt, 700-r.p.m., 3-ph., 60-cy. Gen. Elec., sq. cage
Motor, 60-hp., 440/220-volt, 720-r.p.m., 3-ph., 60-cy. West. sq. cage
Gen. 15-kw., 250-volt, 1140-r.p.m., comp. wd. Cr.-Wh., "CCD"
Motor, 25-hp., 440 or 220-volt, 1140-r.p.m., 3-ph., 60-cy., sq. cage
The above is a partial list; quotations covhring other machines upon request.

Power Machinery Exchange

1 Montgomery Street, Jersey City, N.J.

A. C. Direct-Connected Units—3- or 2-Phase

Kva.	Generator	Engine
640	Wghse.	Hamilton Corliss
625	Wghse.	Parsons Horiz. Turbine
600	Gen. Elec.	Rice-Sargent-Corliss
500	Allis-Chal.	Allis-Chal.-Corliss
500	Allis-Chal.	Allis-Chal. Turbine
400	Wghse.	Erie Ball, 4-valve
400	Wghse.	Hamilton Corliss
375	Gen. Elec.	Erie Ball, 4-valve
375	Gen. Elec	Curtis Horiz. Turbine
360	Gen. Elec.	Harris Corliss
350	Wghse.	Murray Corliss
300	Gen. Elec.	Allis-Chal.-Corliss
250	C.-W.	Harrisburg, 4-valve
250	Wghse.	Erie City, 4-valve
250	Wghse.	Murray Corliss
200	Wghse.	Erie Ball
200	Wghse.	Harrisburg, 4-valve
187	Gen. Elec.	Skinner compound
180	Gen. Elec	Chandler Taylor, side crank
150	Gen. Elec.	Ames Uniflow
125	Gen. Elec.	Curtis Horiz. Turbine
125	Wghse.	Harrisburg, 4-valve
100	Ridgway	Ridgway, side crank
100	Wghse.	Erie Ball
90	Allis-Chal.	Skinner
75	Gen. Elec	Harrisburg
75	Ridgway	Ridgway, side crank
70	Wghse.	Skinner
50	West. Elec.	Erie Ball
40	Fbks.-Morse	Lycoming

A. C. Belted Generators, 3- or 2-Phase

Kva	Make	Speed
800	Allis-Chalmers, 3 Brg.	360
500	Allis-Chalmers	600
400	General Electric, 3 Brg.	600
360	Westinghouse	360
312	General Electric	450
280	Allis-Chalmers	450
250	Allis-Chalmers	600
200	General Electric	600

Kva.	Make	Speed
200	Westinghouse	600
170	General Electric	400
150	General Electric	600
100	General Electric	900
75	Westinghouse	900
60	Electric Machinery	600
50	General Electric	1200
40	Electric Machinery	1200
37½	General Electric	1200
30	General Electric	1200
15	Fairbanks-Morse	1200

A. C. Motors 3- and 2-Phase

Hp.	Make	Volts	Speed
300	Gen. Elec., Synch.	2300	720
200 (3)	Gen. Elec., slip ring	2300-440-220	585
150	Gen. Elec., slip ring	440	720
100	Wghse., slip ring	2300	580
100	Allis-Chal.	440-220	680
85	Gen. Elec.	2300-550-220	720
50	Wghse.	440-220	850
40	Wghse.	440-220	850
30	Wghse.	440-220	850

Also smaller sizes

Direct-Current Units 220-250-Volt

Kw.	Generator	Engine
17½	Wghse.	Erie
20	Gen. Elec.	Gen. Elec
25	Gen. Elec., 3 wire	Troy Vertical
35	Ridgway	Ridgway
35	Allis-Chal.	Skinner
50	Wghse., 3-wire	Ames
50	Gen. Elec.	Erie Ball
75	Sturtevant	Sturtevant
75	Burke, 3-wire	Ames

Kw.	Generator	Engine
75	Allis-Chal.	Erie Ball
85	Cr.-Wh.	Erie Ball
100	Cr.-Wh.	Harrisburg, side crank
100	Allis-Chal.	Skinner
125	Wghse.	Erie, side crank
125	Gen. Elec.	Ball Tandem
150	Wghse.	Hewes Phillips Corliss
150	Ridgway	Ridgway
150	Gen. Elec.	Erie, 4-valve
200	Gen. Elec.	Bates Corliss
200	Ridgway	Ridgway
250	Cr.-Wh.	Harrisburg
250	Gen. Elec.	Erie Lentz
250	Triumph, 3-wire	Skinner tandem
300	Cr.-Wh.	Watts-Campbell-Corliss
300	Wghse.	Lane & Bodley Corliss
400	Gen. Elec.	Buckeye comp.
800	Ridgway	Ridgway Turbine

Oil Engines

Hp.	Make	Type
300	De La Vergne	FH
180	Allis-Chal.	Semi-Diesel
100	Fairbanks-Morse	Y
85	Bessemer	Elec. Light
75	Fairbanks-Morse	Y
60	Muncie	C Heavy Duty
50	Fairbanks-Morse	Y
50	De La Vergne	HA
37½	Fairbanks-Morse	Y
30	Muncie	A
25	Fairbanks-Morse	Y
20	Fairbanks-Morse	
15	Meits & Weiss	Hor.

Direct-Connected Oil and Gas Units

Kva.	Generator	Engine
160	G. E., 3-60-2300-v.	Diesel Oil, 3-cyl.
100	G. E., 3-60-2300-v.	Diesel Oil, 4-cyl.
150	Allis-Chal., 250-v.	Diesel Oil, 3-cyl.
125	Allis-Chal., 230-v.	Turner Frick, gas, 4-cyl.
75	Wghse., 230-115-v.	Diesel Oil, 3-cyl.

MOTORS

220-440-Volt, 3-Ph., 60-Cy., 40-Deg., List 3

Qu.	Hp.	New or Used	Sp. Rpm.	Type	Make
1	30	U	865	Sl. Ring	Allis

Above has drum starter and is especially suited for operating ice making or refrigerating machines o air compressors.

*3	75	U	900	Int Starter	G. E.
*4	100	U	720	Int Starter	G. E.
*1	100	U	720	Int Starter	G. E.
*1	100	U	720	Sl. Ring	G. E.

Above is 50° motor with drum starter and oil switch

3	100	N	900	KT356	G. E.

Above motors are 50° motors with No. 1003 acid proof insulation. Were bought new in 1921 and never uncrated.

1	300	U	590	Sl. Ring	Allis

Above is mill type motor

1	350	N	575	Sl. Ring	WH
1	400	U	505	Sl. Ring	Allis

Above motor for direct connections.

1	500	U	450	Sl. Ring	Cr.-Wh.

Above is mill type motor.

2200-Volt, 3-Ph., 60-Cy., List 3K

1	200	U	600	Sl. Ring	G. E.
1	300	U	705	Sl. Ring	Allis
1	350	U	350	Sl. Ring	WH

220-440-Volt, 3-Ph., 25-Cy., List 6

1	200	U	480	Sl. Ring	G. E.
1	350	U	480	C-Sq. Cage	WH

Above is coupled motor.

1	350	U	475	CCL Sq. Cg.	WH

Above is 3 bearing motor for belting but is without pulley.

1	500	U	161-242	Sl. Ring	WH

Above is 2-speed motor for direct connections.

Motors—220-440-Volt, 3-Ph., 25-Cy., List 6

2	750	U	500	IK	G. E.

Above is for direct connection also has shaft and pulleys and flexible coupling for belting drive.

2200-Volt, 3-Ph., 25-Cy., List 6K

*1	450	N	375	Sl. Ring	G. E.
1	450	U	365	Sl. Ring	G. E.

D. C., 220-Volt, List 9

1	150	U	250-400	K-Cpd.	Diehl

Above motor most suitable for economically operating ammonia or air compressor at variable speeds inaccordance with seasonable or demand loads. Also have available a number of new D. C. motors 3 to 60 hp. from stock shipments.

A. C. Turbo-Generator Set

1—Used 780-kva. LOW pressure Horz. Generator: Westinghouse, 3-ph., 60-cy., 480-volt, 3600-r.p.m. Turbine: Westg. low pressure steam 16¾ lbs. abs; has auxiliary admission valve to make up deficiency by high pressure steam at 125 lb. Condenser: Westinghouse Le Blanc Jet with turbine driven circulating and air pumps. Exciter: Westinghouse 16-kw., D.C., 125-volt shunt wound, direct connected to Vertical WH single acting twin cyl. steam engine. Sw. Bd: 2 panels for generator and exciter and 2 feeder panels. Cooling Tower: Wheeler Cooling Tower complete except 35-hp. electric motor to drive fans. Also have some spare parts.

Motor Generator Set, List 51

1—New 750-kw., D.C., 125-250-volt, cpd. wh., direct connected to a 1150-kva., 3-ph., 60-cy., 2300-volt WH Syn. motor. Aux.: Sw. Bd.

Above has 2—375-kw., 125-volt Generators. The motor is 1150-kva. capacity to operate at 70 per cent Leading Power Factor at full load on generators to correct the low power factor on the inductive load portion of the plant.

D. C. Engine Generator Sets

1—Used 4-kw. Vertical Pallion D.C., 100-v. dynamo dir. conn. to Vertical Sunderland marine type steam, 450 r.p.m. Price $350.00.

1—Used 4½-kw. Vertical Standard Gasoline Engine, two cylinder with flywheel governor and magneto, dir. conn. to 4½-kw. Robbins & Myers D.C., 120-v. generator. Price $500.00 net.

1—Used 7½-kw. Vertical Diehl Generator, D.C., 115-v., dir. conn. to Westinghouse Vertical single acting automatic steam engine, 750 r.p.m. Price $300.00.

1—Used Horizontal 10-kw. Eddy, D.C., 110-v. Generator dir. conn to LH center crank horizontal Ideal 6 x 6 non-cond. engine with wheel governor. Price $325.00.

S—P—E—C—I—A—L—S

1—Used 15-kw., D.C., 125-v. Generator, 285 r.p.m., dir. conn. to 20-hp. N Y safety horizontal engine, LH center crank, wheel governor 8¼ x 9. There is no sub-base between engine and generator but same can be assembled on solid foundation. Price $325.00.

1—Used Horizontal 35-kw. General Electric, late type interpole, compound wound, D.C., 125 v., dir. conn. to a Chuse side crank single valve late type 10 x 10 left hand engine, 200 r.p.m., self-oiling wheel governor, engine non-cond., floor space 7 ft. 6 in. long by 7 ft. wide. This unit is in splendid condition, commutator excellent. Price $800.00 net. Switchboard $100 net.

1—Used Horizontal 40-kw. Eddy D.C., 125-v. generator, dir. conn. to a Watertown 11 x 10 right hand center crank, non-condensing engine. This unit has always given good service. Floor space 8 ft. long by 8 ft. wide. Price $700.00 net. Switchboard $100 net.

Electric Welding Equipment

1—Electric Welding Co. of America, Gasoline Driven Outfit, self-contained in steel frame, capacity 160 amp., max. voltage 60 v., 700 r.p.m., 4 cyl. vertical automobile type gasoline engine with magneto, carburetor, fan and large radiator. Price $975.00.

Dynamos for Plating and Electro-Galvanizing

1—Used complete Electro-Galvanizing Plant for angles, tubes and other parts, complete with 12½-kw., 2500 amp., 5-v. plating dynamo, self-exciting, dir. conn. to 20-hp., 220-v., D.C., 625 r.p.m. motor (If necessary a different motor can be substituted). Includes 7 large wooden tanks, racks, buss bars. This is an unusual opportunity to purchase an up-to-date plant at a fraction of its cost and thereby cut your "Overhead" and investment.

STANDARD ELECTRIC MACHY CO. BALTIMORE

7 and 9 East Hill St., Baltimore, Md., U. S. A.

MAC GOVERN & COMPANY, INC.
POWER MACHINERY

114 Liberty St. New York, N.Y.

FOR PROMPT DELIVERY

TURBO-GENERATOR UNITS

60 CYCLE

1—4000-kw. Westinghouse-Parsons horizontal turbo unit, 3 ph., 2400 v., 1040 amps., 3600 r.p.m., turbine double flow, 150 lbs. steam pressure, 20-in. vacuum. Complete with exciter, switchboard, condenser and auxiliaries.
1—4000-kw. Allis-Chalmers horizontal turbo unit, 3 ph., 4150 or 2300 v., 4-wire, 1800 r.p.m., multiple expansion, parallel and full annular flow, 185 lbs. steam, with condenser and auxiliaries.
1—3000-kw. Westinghouse-Parsons horizontal turbo unit, 3 ph., 4400 or 2300 v., 1200 r.p.m., single flow, 150 lbs. steam, 28-in. vacuum, with switchboard, condenser and auxiliaries.
1—1500-kw. Westinghouse-Parsons horizontal turbo unit, 2 ph., 2400 v., 390 amps., 3600 r.p.m., 150 lbs. steam, 28-in. vacuum, complete with switchboard, condenser and auxiliaries.
2—1000-kw. Westinghouse-Parsons horizontal turbo unit, 3 ph., 2400 v., 4-pole 360 r.p.m., multiple expansion, parallel flow, 3-stage, 150 lbs. steam pressure; 100 deg. superheat, 28-in. vacuum, complete with switchboard, condenser and auxiliaries.
1—1000-kw. Allis-Chalmers horizontal turbo unit, 3 ph., 2300 v., 3600 r.p.m., 165-lb. gauge throttle pressure, 125 deg. superheat, 28-in. vacuum, with condenser and auxiliaries (80% P. F.)
1—500-kw. General Electric-Curtis horizontal turbo units, 3 ph., 2300 v., 3600 r.p.m., complete with condensers.
3—500-kw. Westinghouse-Parsons horizontal turbo units, 3 ph., 60 cy., 2400 v., 3600 r.p.m., complete with No. 5 LeBlanc jet condenser, switchboard, etc.
1—400-kw. Allis-Chalmers horizontal turbo unit, 3 ph., 2300 v., 126 amps., 3600 r.p.m., 125 lbs. steam pressure, with condenser and auxiliaries.
1—300-kw., Allis-Chalmers horizontal turbo unit, 3 ph., 4400 v., 3600 r.p.m., 150 lbs. steam, 28-in. vacuum, with exciter, switchboard, condenser and auxiliaries.

ENGINE-GENERATOR SETS

60 CYCLE, 2 AND 3 PHASE

1—500-kw. Westinghouse, 2300 v., 120 r.p.m., direct connected to 26-in. x 42-in. Hamilton Corliss engine.
1—500-kw. Westinghouse, 2300 v., 3 ph., 120 r.p.m., direct connected to 26-in. x 42-in. Hamilton Corliss engine.
1—500-kw. Allis-Chalmers, 2300 v., 120/150 r.p.m., direct connected to 26-in. x 36-in. Allis-Chalmers engine.
1—450-kw. General Electric, 2300 v., 100 r.p.m., direct connected to 22-in. x 42-in. x 48-in. E. P. Allis cross compound engine.
1—325-kw. Allis-Chalmers, 2300 v., 120 r.p.m., direct connected to 16½-in. and 40-in. x 36-in. Buckeye horizontal tandem engine.
1—260-kw. Allis-Chalmers, 2300 v., 120 r.p.m., dir .conn. to 16½-in. and 40-in. x 36-in. Buckeye horizontal tandem engine. nected to 23-in. x 30-in. Erie City 4-valve engine.
1—300-kva. General Electric, 2300 v., 150 r.p.m. direct con-
1—300 kw. General Electric, 2400 v., 150 r.p.m., direct connected to 24-in. x 30-in. Ball Corliss valve engine.
1—250-kw. Allis-Chalmers-Bullock, 240 v., 150 r.p.m., direct connected to Erie Ball 4-valve engine.
1—225-kw. Westinghouse, 2300 v., 150 r.p.m., direct connected to 14-in. and 26-in. x 30-in. Hamilton Corliss horizontal cross compound engine.
1—200-kw. Westinghouse, 2200 v., 180 r.p.m., direct connected to 18-in. and 30-in. x 24-in. Harrisburg cross compound engine.
1—150-kw. General Electric, 220/240 v., 157 r.p.m., direct connected to 16-in. x 16-in. Chandler and Taylor slide valve engine.

This is only a partial list. Complete list will be mailed upon request.
We are in the market to buy—Advise us what you have to dispose of.

NOTHING BUT GOOD EQUIPMENT

New and Used—Guaranteed Condition—Ready to Ship

Slip Ring Motors—3-Phase, 60-Cycle

Hp.	*Volt*	*Speed*	*Make*	*Type*
500	2200	600	General Electric	M
250	2200	600	General Electric	M
200	220/440	600	Allis-Chalmers	ANY
200	2200	600	General Electric	M
200	440/220	450	General Electric	M
200	220/440	600	General Electric	M
150	2200	720	General Electric	M
150	2200	600	General Electric	M
150	440/220	720	General Electric	M
100	440/220	720	General Electric	M
100	2200	720	General Electric	M
100	440/220	900	General Electric	M
75	550	900	General Electric	MT
75	550	600	General Electric	M
75	2200	720	General Electric	M
75	220/440	720	General Electric	M
75	440/220	900	General Electric	M
60	440/220	900	General Electric	MT
50	550	900	General Electric	MT
50	440/220	1200	General Electric	MT
50	2200	900	General Electric	MT
40	440/220	900	Allis-Chalmers	ANY
40	440/220	1200	General Electric	MT
30	440/220	900	Allis-Chalmers	ANY

Squirrel Cage—3-Phase, 60-Cycle

150	2200	720	General Electric	K
150	2200	600	Western Electric	SS
100	2200	600	General Electric	K
100	440/220	900	General Electric	K
100	440/220	720	General Electric	K
100	2200	900	General Electric	K
75	440/220	900	General Electric	K
50	440/220	1200	General Electric	K
50	440/220	900	General Electric	K
50	550	900	General Electric	K
40	220/440	1200	General Electric	KT
35	220/440	720	General Electric	K
30	220/440	900	Allis-Chalmers	AN
30	220/440	900	Westinghouse	CS
30	220/440	1200	Allis-Chalmers	AN
30	220/440	720	Allis-Chalmers	AN
25	440/220	900	General Electric	KT
25	440/220	600	General Electric	K
25	440/220	600	Allis-Chalmers	AN
25	220/440	720	General Electric	K
25	440/220	1200	Westinghouse	CS
20	440/220	1200	General Electric	L
15	440/220	1200	General Electric	L
10	440/220	1200	General Electric	L
10	440/220	900	General Electric	KT

3-Phase, 25-Cycle

500	2200	500	General Electric	Sl. rg.
300	440	500	General Electric, sl. rg.	
200	440	500	General Electric, sl. rg.	
50	220/440	750	General Electric, sq. ca.	

DIRECT CURRENT MOTORS

Hp.	*Volt*	*Speed*	*Make*	*Type*
100	230	900	General Electric	RC
100	230	500	General Electric	DLC
90	230	500	General Electric	CL-A
75	230	1100	Westinghouse	S
75	115	475	Westinghouse	SA
75	500	750	Westinghouse	M
75	230	500	General Electric	DLC
50	230	1125	Westinghouse	S
35	230	800	Westinghouse	S
30	230	300	Westinghouse	M
30	230	700	G. E.-Sprague	D
15	230	1000	General Electric	CQ
10	230	1150	General Electric	RC
10	115	1460	Allis-Chal.	B

DIRECT CURRENT GENERATORS

Kw.	*Volts*	*Speed*	*Make*	*Type*
125	125	850	General Electric	DLC
100	250	1050	General Electric	RC
100	250	575	General Electric	CL-A
85	125	750	General Electric	MP-H
75	250	575	General Electric	DLC
70	125	575	Westinghouse	SA
33	125	725	General Electric	Sprague
30	250	850	G. E. Sprague	D
23	125	1175	Crocker-Wheeler	I

MOTOR GENERATOR SETS

1—125-kw., 125-volt, 900-r.p.m. General Electric, D.L.C. Interpole Generator, coupled to 150-kva., 440/220-volt, 3-phase, 60-cycle Westinghouse self-starting synchronous motor.
1—90-kw., 250-volt, 1150-r.p.m., Gen. Elec., RC interpole Generator, coupled to 150-hp. 440/220 volt, 3-phase, 60-cycle Gen. Elec. S Cage motor.
1—70-kw., 125-volt, 580-r.p.m. Westinghouse SA interpole Generator, coupled to 100-hp., 2200/440/220-volt, 3-phase, 60-cycle Gen. Elec. S Cage motor.
1—50-kw., 125-volt, 1150-r.p.m., Gen. Elec. RC interpole Generator, coupled to 75-hp., 440/220 volt, 2 or 3 ph., 60-cy., Gen Elec. S cage motor.
1—23-kw., 125-volt, 1150-r.p.m. Crocker-Wheeler, type I, compound wound Generator, coupled to 35-hp., 220/440, 3-ph., 60-cy. G. E., form K Motor.

ALTERNATING CURRENT GENERATORS

1—225-kva. Westinghouse, 220-volt, 514-r.p.m., 2- or 3-phase, 60-cycle, R. F. Generator, with belted exciter.
1—200-kw. Allis-Chalmers, 2300-volt, 600-r.p.m. 3 or 2-phase, 60-cycle, RF Generator with direct connected Exciter.
1—150 kva. Westinghouse 240/480-volt, 900-r.p.m., 3-ph., 60-cy., R. F. Generator with belted exciter complete.
1—100-kva. Westinghouse, 240/480-volt, 900-r.p.m., 3-phase, 60-cycle, R. F. Generator, with belted exciter, complete.
1—50-kw. Westinghouse 2300/480/240-volt, 1200-r.p.m., 3-phase, 60-cycle RF Generator, with belted exciter.

ENGINE GENERATOR SETS

1—160-kw., 250-volt, 230-r.p.m. General Electric, type MP, form L, direct current Generator, direct connected to 17 x 16 Harrisburg Standard side crank engine.
1—150-kw., 250-volt, 225-r.p.m. General Electric, type MP, form RB, direct current Generator, direct connected to 16 x 18 Harrisburg side crankleft-hand engine.
1—80 kw., 250/125-volt, 280 r.p.m., 3 wire Sprague D.C. Generator, direct connected to 13 x 14 Ridgway side crank right-hand engine.

We also have a number of other desirable Engine Generator Sets—both A.C. and D.C. and a large stock of 2-phase Motors.

STEPHEN HALL & CO., Inc., 7th and Adams Streets, Hoboken, N. J.

TELEPHONES: New York Direct Wire: Rector 3891; HOBOKEN 3750

ARCHER & BALDWIN, Inc.

114-118 LIBERTY ST., NEW YORK CITY

TELEPHONES 4337-4338 RECTOR

250 VOLT UNITS

1—500 kw., Burke, 150 r.p.m., dir. con. 22 and 38 x 27 in. Erie Ball, 4-valve engine.
1—180 kw., Ft. Wayne, 250 r.p.m., dir. con. 16 x 18 McEwen engine.
1—100 kw., Crocker-Wheeler, 250 r.p.m., dir. con., Harrisburg engine.
1—75 kw., Westg., 275 r.p.m., dir. con. 13 x 12 Ballwood engine.
1—50 kw., Westg., 300 r.p.m., dir. con. 11 and 19 x 11 Westg. engine, 3 wire.

125 VOLT UNITS

1—75 kw., Northern, 270 r.p.m., dir. con. 15 x 14 Payne engine.
1—75 kw., Gen. Elec., 275 r.p.m., dir. con. 14 x 14 straight line engine.
1—30 kw., Westg., 325 r.p.m., dir. con. 10 x 10 Harrisburg engine
1—30 kw., Sturtevant, 325 r.p.m., dir. con. 9 x 9 Sturtevant engine.

550 V. BELTED GENER. AND MOTORS

1—300 kw., Sprague Lundell, 470 r.p.m.
1—100 kw., Westg., 720 r.p.m., 2-bearing.
1—20 hp., Bullock, 925 r.p.m.

250 V. BELTED GENER. AND MOTORS

1—400 kw., Allis-Chal., 415 r.p.m., 3-bearing.
1—150 kw., Gen. Elec., 450 r.p.m., 2-bearing.
1—80 hp., Gen. Elec., 490 r.p.m., hoist type.
1—35 hp. Bullock, 1175 r.p.m.
1—30 hp., Diehl, 725 r.p.m.
1—15 hp., Gen. Elec., 1100 r.p.m.

125 V. BELTED GENER. AND MOTORS

1—200 kw., Bullock, 300 r.p.m., 3-bearing.
1—200 kw., Westg., 365 r.p.m., 2-bearing.
1—90 hp., Gen. Elec., 500 r.p.m.
1—40 kw., Westg., 550 r.p.m.
1—25 hp., Triumph, 1100 r.p.m.
1—20 hp., Western Elec., 900 r.p.m.
1—15 hp., Gen. Elec., 690 r.p.m.
1—15 hp., Westg., 725 r.p.m.
1—13-kw. Crocker-Wheeler, 950 r.p.m.
1—10-hp. Crocker-Wheeler, 1100 r.p.m.
1—8-kw. Ft. Wayne, 1950 r.p.m.

MOTOR GENERATOR SETS

1—300-kw., G. E., 220-v. Generator, with a 450-hp., G. E., 2300/4150-v., 3-ph., 60-cy., 720 r.p.m. motor.
1—150-kw., Westg., 250-v. Generator, with a 225-hp., Westg., 3-ph., 25-cy., 6600- or 2200-v., synch. motor, 550 r.p.m.
1—150-kw., Westg., 250-v. Generator, with a 250-hp., Westg., 3-ph., 60-cy., 2200-v., ind. motor, 580 r.p.m.
1—100-kw., Elec. Machy. Co., 250-v. Generator, with 150-hp., 2- or 3-ph., 60-cy., synch. motor, 900 r.p.m.
1—100-kw., Westg., 230-v. Generator, with 150 hp., 3-ph., 60-cy., 2200-v. ind. motor, 580 r.p.m.
1—10-kw., Westg., 125-v. Generator, with 15-hp., 3-ph., 60-cy., 440-v. motor, 1120 r.p.m.
1—10-kw., Sprague, 240-v., Generator, with 15-hp., 3-ph., 60-cy., 220-v., 1800 r.p.m. motor.

THE NATIONAL POWER MACHINERY CO.

ELECTRICAL ENGINEERS
POWER PLANT EQUIPMENT

1914-1918 SCRANTON ROAD, CLEVELAND, OHIO

Government Turbine Generating Units For Sale—
Practically New—Prompt Shipment

Location: Government Plant at Nitro, West Virginia

3—1250 kva. horizontal General Electric Curtis non-condensing turbine generating units, each consisting of
GENERATOR—1000 kw., 80 per cent P. F., 1250 kva., General Electric, 3 ph., 60 cy., 6600 or 2300 v., 3600 r.p.m. type ATB-2-1250 form T, serial Nos. 1353490, 1353503, 1353625, direct connected to
TURBINE—General Electric non-condensing single stage form B 3600 r.p.m. 175 lbs. steam pressure, 100 deg. F Superheat, serial Nos. 19117, 19118, 19119.
EXCITER—13 kw., 125 volt, 104 amp., 3600 r.p.m., type E.D., form T, serial Nos. 661971, 661972, 661973, direct connected to generator.

These outfits are of the latest type turned out by the manufacturers. Two of these units have been in service approximately eighteen months and one only six months.

They can be operated at steam pressure of 150 to 200 lbs., and a superheat from 0 deg. F to 100 deg. F.

The electrical end of these units can be readily changed for the following voltages:—240 volts, 480 volts, 550 volts.

Special prices and detailed information will be quoted on application.

In addition to the above outfits, we also have a large stock of **Engine Driven Generating Units, Motor Generator Sets, Rotary Converters, Transformers, Motors, Generators** and **Boilers.** Send for our Stock Catalogue No. 42 for complete list.

POWER

A.C. ENGINE SETS

90-kva., Westinghouse, 2-ph., 60-cy., 2300-v., with Erie Ball side crank engine.
150-kva., General Electric, 3-ph., 60-cy., 2300-440-220-v., with Hamilton 4-valve engine.
175-kva., General Electric, 2-ph., 60-cy., 240-v., with Skinner Unaflow engine.*

D.C. ENGINE SETS

6-kw., Milwaukee with 6 x 5 Vertical engine.
10-kw., C & C, 125-v., with 6 x 6 vertical Racine engine.
20-kw., Diehl, 115-v., with American Blower eng.
20-kw., Crocker-Wheeler, 125-v., with Harrisburg engine.
30-kw., General Electric, 125-v., with Harrisburg engine.
50-kw., Westinghouse, 125-v., with Ames eng.
50-kw., Westinghouse, 250-v., with Skinner eng.
75-kw., Crocker-Wheeler, 125-v., with Ames eng.
150-kw., General Electric, 3-wire, 125-250-v., with Erie Ball side crank engine.
150-kw., Westinghouse, 250-v., with Erie Ball engine.
150-kw., Western Electric, 3-wire, 125-250-v., engine type generator, 200 r.p.m.
225-kw., C & C, 250-v., with Hamilton, 4-valve engine.*

BELTED ENGINES

7 x 8 Sturtevant vertical.
7 x 8 Ames, Vim automatic.
8 x 8 O & S vertical
12 x 12 Buffalo Forge, center crank automatic.
14 x 12 Ames automatic, center crank.
14 x 16 Erie City, automatic.
15 x 14 Ames, automatic, side crank.

SQUIRREL CAGE MOTORS
3 Phase—60 Cycle

Hp.	Volts	Speed	Make	Type
10	440-220	1740	Westinghouse	C.S.
10	440	1750	Triumph	B-8 5
10	440	1745	Allis-Chalmers	.....
10	440	1200	Fairbanks-Morse	N.I.
50	440-220	900	General Electric	I.
50	440-220	900	Fort Wayne	.....
75	440-220	900	General Electric	I.
50	440	865	Allis-Chal. (S.R.)	Y

SQUIRREL CAGE MOTORS
2 Phase—60 Cycle

35	220-440	900	General Electric	I.Q.
35	220-440	720	General Electric	I.Q.

DIRECT CURRENT MOTORS

Quantity of small motors, 1-hp. to 25-hp. in stock.

Above equipment owned by us except items marked *

COLEMAN-SHOEMAKER, Inc., Office, Plant and Siding 20th and Clearfield Sts., Phila.

"HONESTLY REBUILT" ELECTRICAL MACHINERY

3-Ph., 60-Cy., 220/440-Volt Motors

Qu.	Hp.	Make	Type	Speed
	5	General Electric	KT	1200
	5	Wagner	BM	1720
6	7½	General Electric	KT	1800
2	10	Allis	AN	1200
	10	General Electric	KT	1800
2	10	General Electric	KT	900
50	15	General Electric	KT	900
75	20	General Electric	KT	900
45	25	General Electric	KT	900
3	30	Westinghouse	CX	1200
1	30	Westinghouse	CCL	1800
55	30	General Electric	KT	900
40	35	General Electric	KT	900
21	40	General Electric	KT	900
1	50	Westinghouse	CCL	900
5	50	General Electric	KT	1200
6	60	General Electric	KT	1200
1	60	Westinghouse	CS	900
1	75	General Electric	KT	1200
	100	General Electric	KT	1200

Direct Current Motors

Make	Kw.	Rpm.	Volts
General Electric	105	665	250
General Electric	100	290	250
Crocker-Wheeler	100	900	250
General Electric	75	1200	250
General Electric	75	1200	500
General Electric	75	850	250
General Electric	70	700	250
General Electric	55	845	250
Westinghouse	50	850	250
General Electric	50	550	500
Westinghouse	50	550	250
General Electric	35	550	250
General Electric	30	1700	250
General Electric	25	750	250

3-Ph., 25-Cy., 220/440-Volt Motors

Qu.	Hp.	Make	Type	Speed
2	10	General Electric	KT	750
7	25	Westinghouse	CS	750
1	35	General Electric	CS	750

Direct Current Generators

Make	Kw.	Rpm.	Volts
General Electric	500	360	250
General Electric	400	450	250
Allis-Chalmers	200	425	250
General Electric	150	550	250
General Electric	100	550	250
Crocker-Wheeler	75	1200	250
General Electric	60	900	250
Westg. Erie City	100	250	250
Allis Skinner	100	250	125
G. E. Buckeye	150	200	250
Westg. Ball	200	200	250
Westg. Buckeye	300	150	250
G. E. McIntosh	450	150	250
G. E. Hamilton	500	150	250

Also a number of very attractive offerings in Alternating Current, Belted and Engine Driven Generators.

MILLER-OWEN ELECTRIC CO., Inc.

LEXINGTON AVE. AND THOMAS BOULEVARD PITTSBURGH, PENNA.

Motor Generator Sets

Make	Kw.	D.C. Volt	A.C Volt
General Electric	200	250	2300
General Electric	150	250	2300
Allis	150	500	2300
General Electric	100	250	2300
Burke	75	500	2300
Crocker-Wheeler	75	250	220/440
Allis	75	250	2300
General Electric	65	250	220/440
General Electric	50	250	220/440
Westinghouse	50	125	220/440

A. C. Motors

Make	Hp.	Rpm.	Cycles
General Electric	750	514	60
General Electric	750	750	25
Crocker-Wheeler	600	514	60
Westinghouse	400	450	60
General Electric	300	500	25
General Electric	275	600	60
General Electric	200	450	60
General Electric	150	720	60

Independent Electric Machinery Co.

Twentieth and Central Sts., Kansas City, Mo.

SEE THE INDEPENDENT FIRST

PARTIAL STOCK LIST

All Apparatus Listed Below in Stock for Prompt Shipment

SEE THE INDEPENDENT FIRST

3-Ph., 60-Cy., ALTERNATORS

2—20-kva., 2300-volt, 60-cycle, 3-phase, 1800-r.p.m., Type A.B. Fairbanks-Morse Belted Alternators, complete with exciter and etc.

1—62-kw., 2200-volt, 60-cycle, 3-phase, 300-r.p.m. Bullock Alternator, direct connected to an Almes steam engine, all complete

1—75-kva., 2300-volt, 900-r.p.m., Rev. Field Belted Allis-Chalmers complete with belted exciter.

1—100-kva., 2300-volt, 3-phase, 60-cycle, 900 r.p.m., W. E. Belted Alternator complete.

2—100-kw., 440-volt, 60-cycle, 3-phase, 3600-r.p.m. General Electric Curtiss type turbines, complete with jet condensers for each machine, driven by steam pumps, two synchronous motor generator exciter sets, one Curtiss turbine exciter set, all complete with necessary rheostats and nine-panel switchboard.

1—150-kva., 2300-volt, 720-r.p.m. Rev. Field Belted Elec. Machinery Co., complete with belted exciter.

3 Ph., 60 Cy., 220/440 Volt Motors

No.	*Hp.*	*Make*	*Speed*
4	30	G. E., New	1200
6	30	Robbins & Myers	1150
1	30	Allis-Chalmers, Rebuilt	860
1	30	W. E., Rebuilt	900
1	30	G. E., slip ring, New	900
4	30	G. E., Rebuilt	1200
2	30	F.-M., Rebuilt	1200
1	30	Westg., 2200-v., Rebit.	1120
1	35	Wagner, Rebuilt	1730
1	35	Wagner typeBWRebit.	900
6	40	Watson, Rebuilt	1200
3	40	Watson, New	1200
1	150	G.E., slip ring, Rebuilt.	695

220-VOLT, D. C. GENERATORS

Kw.	*Make*	*Speed*
2—15	Imperial	900
1—30	Northern	650
1—40	Western Electric	775
1—60	Commercial	700
1—75	Fairbanks-Morse	750

220-VOLT, D.C. MOTORS

Hp.	*Make*	*Speed*
1— 25	Crocker-Wheeler, Re.	750
2— 30	G. E. (vertical)	1500
1— 35	Westinghouse	1420
2— 35	Crocker-Wheeler	750
1— 40	Jenny	2000
1—100	Westinghouse	450
1—110	Crocker-Wheeler	560

Direct Current Engine Sets

1—100-kw., 220-volt, 400-amp., 225-r.p.m., comp. wd. Jenny Generator, direct connected to 14 x 18 Four-valve Ideal steam engine.

2—100-kw., 220-volt, 150-r.p.m. Western Elec. Generator, direct connected to Fitchburg Tandem comp. steam engine.

1—400-kw., 220-volt Western Electric compound wound Generator, 140-r.p.m., direct connected to 18x28x30 Fitchburg tandem compound steam engine.

BALANCER SETS

2—5-kw., Type CCM, 125-volt, 1500-r.p.m., 35-amp. Crocker-Wheeler, 2 bearing.

1—5-kw., 110-volt, 45-amp., 1250-r.p.m. Gregory, 2 bearing.

1—15-kw., 110-volt, 1250-r.p.m. Jenny, 2 bearing.

2—20-kw., 115-volt, 1200-r.p.m., type EOB4 Western Electric, 4 bearing and coupling.

1—27½ kw., 115-volt, 1025-r.p.m., type EB4A Western Electric, 4 bearing and coupling

JUST PURCHASED LOT OF

500 NEW MOTORS

From Manufacturers of Special Machinery in Original Crates

WAGNER MOTORS

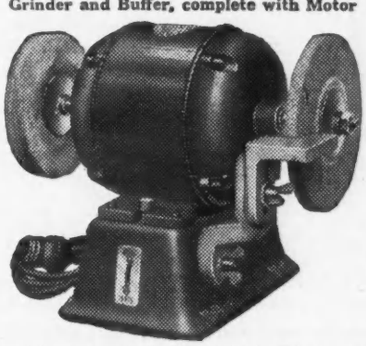
Split Phase, Continuous Duty, 40 Degrees
¼ Hp., 110 Volt, Single Phase, 60 Cycle, 1725 R.P.M. with Pulley

$14.50

Discounts in Quantities
Complete Stock of Motors up to 200 H.P.

500 MARATHON OK $25.00

Grinder and Buffer, complete with Motor



thoroughly efficient shop tool, solidly built for long service.
Weighs 38 lbs. bare or 52 lbs. boxed.
Driven by ¼ hp., motor, guaranteed for 1 year.
Has 6-inch Grinder and 6-inch Buff.
Other makers ask $45.00 to $65.00.

Davis Machine & Motor Co., Inc.

59 Mechanic Street, Newark, N. J.

Tel. Market 8580

Compare These Motor Prices

These are only a few of the bargains we offer, picked at random from our large stock.

New Motors

Hp.	*Make*	*Ph.*	*Cy.*	*Type*	*Volts*	*Rpm.*	*Price*
550	Cr.-Wh.	3	60	Sl. ring	2200	1170	$1875.00
60	Gen. Elec.	3	60	KT.	220	1160	555.00
4— 50	Gen. Elec.	3	60	Sl. ring	440	690	959.00
8— 50	Gen. Elec.	3	60	Sl. ring	220	1200	792.00
50	Gen. Elec.	3	60	Sq. cage	550	600	600.00
40	Westghse.	3	60	CS.	220	1200	440.00
40	Gen. Elec.	3	60	Sl. ring	220	1200	711.50
30	Gen. Elec.	3	60	Sl. ring	440	720	749.75
2— 25	Gen. Elec.	3	60	Sl. ring	220	1200	573.50
12— 25	Gen. Elec.	3	60	KT.	220	1200	302.00
20	Gen. Elec.	3	60	Sl. ring	220	1200	473.00
5— 20	Gen. Elec.	3	60	KT.	220	1200	267.00
15	Gen. Elec.	3	60	Sl. ring	220	1200	422.00
4— 15	Gen. Elec.	3	60	KT.	220	1800	216.00
10	Gen. Elec.	3	60	Sl. ring	440	1200	388.00
5— 10	Bell	3	60	Compensat.	220	1800	216.00
6— 10	Gen. Elec.	2	60	KQ.	220	1200	216.00
6— 7½	Bell	3	60	Compensat.	220	1800	190.00
13— 5	R. & M.	3	60		220	1700	94.00
15— 3	Gen. Elec.	3	60	KT.	550	1800	75.00
200— ¼	W. E.	1	60	SA	110	1800	17.75
55— ¼	W. E.	DC		SD	110	1725	18.75

Used Motors

400	Westghse.	3	60	Synchron.	2200	450	$1000.00
200	Gen. Elec.	3	60	Sl. ring	2200	600	1400.00
200	Gen. Elec.	3	60	Wound ro.	220	580	975.00
200	Westghse.	2	60	Sl. ring	220	580	1275.00
133	Gen. Elec.	2	60	Synchron.	2200	900	600.00
150 kva.	Stanley	2	60	Alternator	2400	900	550.00
2—100	Gen. Elec.	3	60	Sl. ring	440	514	1100.00
75	Gen. Elec.	3	60	Sl. ring	2200	900	825.00
75	Burke	2	60	Sq. cage	220	360	750.00
2— 50	F.-M.	3	60	Sq. cage	220	900	325.00
2— 50	Burke	3	60	Sl. ring	220	1200	475.00
50	Westghse.	3	60	Sq. cage	440	580	500.00
50	Allis-Chal.	3	60	Sq. cage	2300	850	500.00
3— 50	Gen. Elec.	2	60	Sq. cage	220	865	400.00
50	Gen. Elec.	3	60	Wo. rotor	220	514	600.00
50	Gen. Elec.	3	25	Sq. cage	220	715	400.00
40	Westghse.	2	60	Sq. cage	220	1120	300.00
40	Allis-Chal.	3	25	Sq. cage	440	720	375.00
2— 37	Gen. Elec.	3	60	Sl. ring	220	750	450.00
3— 35	Lincoln	3	60	Sq. cage	440	1200	245.00
2— 30	Ideal	3	60	Sq. cage	440	1150	300.00
2— 30	Westghse.	3	25	Sq. cage	220	710	300.00
30	Gen. Elec.	3	25	Sl. ring	220	500	500.00
2— 25	Wagner	3	60	Sl. ring	440	1150	375.00
3— 20	Westghse.	3	25	Sq. cage	220	720	265.00
2— 15	Westghse.	3	25	Sq. cage	220	700	200.00

Direct Current

90	Cr.-Wh.	Comp. wo.	500	690	575.00
90	Diehl	Shunt wo.	240	460	575.00
90	Gen. Elec.	Comp. wo.	220	625	775.00
90	Westghse.	Comp. wo.	220	675	625.00
75	Diehl	Shunt wo.	220	340	575.00
4— 47	Westghse.	Comp. wo.	500	600	375.00

Some have not been used more than 60 days.

All carry our usual ONE YEAR GUARANTEE. 1000 other bargains. LARGEST STOCK OF ITS KIND IN AMERICA.

NATHAN KLEIN & CO.
MOTORS CENTRE & HOWARD STS., N.Y. DYNAMOS

New Motor Special

¼ hp. Westinghouse, A.C. $14.00
1/3 hp. Westinghouse, 1140 r.p.m., A.C.... 29.00
½ hp. Westinghouse, A.C..... 29.50
1/3 hp. Westinghouse, 32 volt, D.C..... 25.00
¾ hp. General Elec., 115 volt, D.C..... 32.50
2 hp. Century, 110/220 volt, A.C..:..... 75.00
3 hp. Century, 110/220 volt. A.C..... 90.00

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HP.	R.P.M.	MAKE
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1— 2	1150	Western Elect RC
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1— 5	1150	Westinghouse S.
2— 5	1650	G. E. C.V.C.
1— 5	950	Crocker-Wheeler
1— 7½	1525	G. E. C.V.C.
1— 7½	1200	Robbins & Myers
1— 10	850	Crocker-Wheeler
1— 10	1050	Westinghouse, S
1— 15	1750	Westinghouse, SK
1— 20	600	Peerless
1— 20	1300	Westinghouse S.
1— 25	875	Crocker-Wheeler
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1— 30	650	Bullock
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HP.	R.P.M.	MAKE
3— 3	1800	Lincoln (new)
1— 3	1800	Gen. Elec.
1— 3	1800	Wagner
1— 3	1200	G. E., Slip-Ring
6— 5	1800	Lincoln (new)
1— 5	1200	Lincoln, new
1— 5	720	Gen. Elec., KT
1— 7½	1200	G. E. (new)
1— 7½	1200	Gen. Elec., KT
1— 10	1200	Western Elec.
1— 10	1200	G. E. (new)
1— 15	1200	Westghse., C.C.L
1— 15	720	Crocker-Wheeler
1— 20	1200	Wagner (new)
2— 40	1150	Allis-Chalmers
1— 50	1150	Gen. Elec. K.T.
1—100	1150	Gen. Elec.

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Used 500 hp. induction motor, squirrel cage winding, rating, Type KT-412-10-500-720, form A, No. 2297848, 60 cycles, 113 amperes, 2200 volts, 720 r.p.m., without pulley and base but including starting compensator. Diameter of shaft 5 7/16 inches, shaft extension, 32 inches. First-class condition.

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1—30 kw. 125 v., 350 r.p.m., Bullock generator, direct connected to 1—Skinner automatic steam engine, complete with valves, piping, and switchboard.
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No.	*Hp.*	*R.p.m.*	*Type*	*Make*
3	40	1200	IK	Gen. Elec
4	40	1200	CS	Westghse.
1	75	720	IM-Sl.Rg.	Gen. Elec.
1	100	900	CS-Sq.Cg.	Westghse.

3-Ph., 60-Cy., 240/480-V. Alternators

No.	*Kva.*	*R.p.m.*	*Type*	*Make*
1	90	900	AB	Fair.-Mor.
1	125	900	ATB	Gen. Elec.

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No.	*Kw.*	*R.p.m.*	*Volts*	*Type*	*Make*
1	150	575	250		Ridgeway
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1—30 kw., 125-v. Ideal Generator, direct connected to 3-ph., 60-cy., 220-volt Ideal Motor.
1—37½ kva., 1200 r.p.m., Type ATB; make, G. E., 3 ph., 60-cy., 2300 v.
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1—50-hp. Allis-Chalmers Induction Motor, continuous duty, 440 v., 3 ph., 60 cy., speed 965, 40 deg., complete with Cutler-Hammer starting controller, oil circuit breaker, base and 14-in. x 9-in. belt pulley.
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1—150 b.hp. vert. 3 cyl. coupled to 100 kw., 250 v. D.C. Genr.
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10—Desk Phones No. 980, 33 pts. on dial.
10—Wall Phones No. 99, 33 pts. on dial.
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System complete for 21 phones without storage battery.

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1—250-kw., 250-rev., 250-v., 3-bearing Electric Machinery, excellent condition.

D.C. MOTORS

3—35-hp., 400-rev., 220-v., Electric Machinery.
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1—25-hp., 600-rev., 220-v., Electric Machinery.
5—25-hp., 650-rev., 220-v. Allis-Chalmers.
2—25-hp., 800-rev., 220-v., R. C. Type, Gen. Elec., nearly new.

All of above complete with starting boxes, pulleys and rails.

Two Spot Welders

25 kw. and 10 kw.

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G. E. Induction Voltage, Type I. R. S.-2. 11.5 K. V. A. 50 amp. 2300 v.

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20—18 x 36 Corliss Engines, 350 HP., heavy duty mill type, either right hand or left hand. Fly wheel 11 ft. x 32 in. Can furnish either new or used. Complete specifications and photographs on request.

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1—40-kw. General Electric, 1050 r.p.m., form H, 125-v., D.C., with switchboard.

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0230

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Spark plugs
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Get the complete catalog of the sale. There are many items of interest to Electrical Contractors among the other classifications of material, and you should check them carefully. Go to Buffalo, if possible.

The Government reserves the right to reject any or all bids.
For catalog and further information write:

Commanding Officer, Curtis-Elmwood Air Reserve Depot,
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1000-1500 kw., direct current railway generator, 600-600 volts, compound wound, 300 r.p.m., complete with bedplate, field rheostat, etc., with shaft suitable for direct connection to synchronous motor which we now have.

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WANTED TO BUY
TURBINE EXCITER

Second Hand Steam Driven, 25 kw. 125 volt compound wound, 150 lb. steam, no superheat, geared or direct drive. Give full description and price.

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Used D. C. Watthour Meters

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ARMATURE winder, experience on A.C. and D.C. machines; permanent and steady position to right party; state age, experience and salary expected. Smith-Bishop Electric Co., P. O. Box 216, Owensboro, Ky.

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RADIO engineer wanted by large electrical manufacturing company. Applicant should be technical college graduate in electrical engineering, with experience in experimental radio development problems involving both transmitting and receiving. None but high grade development engineers need apply. State age, education and experience. Address P-988, Elec. World.

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POSITIONS WANTED

AUDITOR or accountant, with 6 years' experience in public utility accounting, mainly electric and gas, desires to make change; references furnished. PW-28, Elec. World, Old Colony Bldg., Chicago, Ill.

CHIEF electrician, high grade man, fifteen years' practical experience in industrial power and lighting, power plant and substations, desires permanent position; excellent organizing and managing capacity; ten years in charge of work; references. PW-997, Elec. World, Leader-News Bldg., Cleveland, O.

DEVELOPMENT engineer, university graduate, with 3 years' experience in development of manufacturing processes with large electrical manufacturing company, desires development of electrical apparatus or any line of work requiring the practical application of the fundamental engineering laws; age 27. PW-18, Elec. World, Old Colony Bldg., Chicago, Ill.

ELECTRICAL engineer, age 30, married, completed graduate students' engineering course of General Electric Company. Experienced in high-tension transmission and distribution, also industrial plant applications. PW-2, Elec. World, Real Estate Trust Bldg., Phila., Pa.

DESIGNER, technical graduate, experienced on generating and substation layouts, transmission line work and hydroelectric developments, wants position. PW-31, Elec. World.

ELECTRICAL engineer, age 43, technical education; 26 years' unusually broad experience; electrical machinery design, all types, commercial and automotive; also sales service and business management and industrial engineering; available July 1. PW-12, Elec. World, Leader-News Bldg., Cleveland, O.

ELECTRICAL mechanical engineer of 23 years' experience, familiar with modern power plant equipment, operation and combustion, transmission and distribution, etc.; superintendent with public service corporation and municipal utilities; A-1 recommendation submitted. PW-14, Elec. World, Old Colony Bldg., Chicago, Ill.

ELECTRICAL superintendent; technical education; 18 years' experience in manufacturing and repairing of dynamos, electrical machinery; good organizer, capable of handling men and building an efficient organization; at present with large Middle-Western repair company; A-1 reference; available within one month after an agreement. PW-22, Elec. World, Leader-News Bldg., Cleveland, O.

EXECUTIVES

Engineers and men of proven ability seeking positions find our service satisfactory. Our Mr. H. H. Harrison can confidentially negotiate for you suitable connections, as he has successfully done for thousands of others since 1909. Inquiries invited.

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BE A METER ENGINEER

Get in the new profession. We can teach you meter engineering *by mail* at your own home during spare time. Successful graduates everywhere. **Earn $3,600.00 a Year.**

Central stations *must have Electrical Meter Engineers.* They pay high salaries. *Write today.* Just your name and address on a postal and we will send you full particulars free. Ft. Wayne Correspondence School, Dept. 46, Ft. Wayne, Ind.

POSITIONS WANTED

ELECTRICAL, 18 years' technical and practical experience, layout, testing, installation, maintenance operation in power and industrial plants, desires permanent position. PW-993, Elec. World, Old Colony Bldg., Chicago, Ill.

ELECTRICAL engineer, age 32, having 15 years' experience, desires responsible position. Experience covers power plant operation and construction, teaching electrical subjects, winding and redesigning, batteries, telephone engineering, general wiring; familiar with steam, gas and machine shop practice; good business training and interested in selling or executive positions. PW-23, Elec. World, Old Colony Bldg., Chicago, Ill.

ELECTRICAL engineer, technical graduate, 17 years on drafting, designing and construction power stations, sub-stations, electrical transmission lines, also operating work, desires position as engineer or superintendent with large system; now employed in charge of thirty men; age 38, married; member of A. I. E. E.; can handle men and produce results. PW-19, Elec. World, Real Estate Trust Bldg., Phila., Pa.

ELECTRICIAN. 10 years' practical experience in installing, maintenance and general repair of all types electrical equipment; expert A.C. and D.C. Armature winder. Only permanant and steady position preferred (Middle West); available at once. PW-991, Elec. World.

ENGINEER, technical graduate; age 21; desires position as assistant engineer or construction and wiring man, in the Central West states. PW-8, Elec. World, Old Colony Bldg., Chicago, Ill.

ENGINEER, technical graduate, wide experience in general electrical and mechanical engineering in connection with steam electric power plant and industrial equipment, design, construction, maintenance, test and report work, wants position; location anywhere. PW-30, Elec. World.

ENGINEER, graduate, desires position as chief electrician or assistant maintenance engineer of an industrial plant; 2 years' mechanical, 4 years' electrical construction and maintenance; age 29. PW-24, Elec. World.

EXECUTIVE, graduate electrical engineer, age 32, single, desires responsible commercial position with public utility company; 11 years' broad engineering and commercial experience with gas, railway and electric companies covering operation, construction, power sales, rates, statistics, etc. PW-20, Elec. World, Leader-News Bldg., Cleveland, O.

GENERAL line foreman. American, 45, married, 25 years' practical experience, electric light, power trolley construction and maintenance, 15 years having complete charge lineman and construction departments; will accept position East or West where living conditions are good and position permanent. P. O. Box 652, Bristol, Virginia.

GRADUATE electrician wants work; can do house wiring, testing, meter work, A.C. and D.C. armature winding, reconnect motors, motor generator repair and maintenance. Joe Frankovich, Washoe, Mont.

MARRIED man, age 27, wishes position as assistant in meter department, sub-station or power plant; correspondence course on meters and 4 years machine shop. PW-17, Elec. World.

MECHANICAL engineer, 13 years' experience in factory equipment, layout installation and maintenance, familiar with boilers, economy power generation and distribution in large manufacturing plants. PW-998, Elec. World, Real Estate Trust Bldg., Phila., Pa.

POSITION wanted as central station operator or power house superintendent; familiar with up-to-date systems, also those used for 20 years; can make any necessary repairs; used to steam or water driven plants; middle-aged, single, Yankee. PW-15, Elec. World, Old Colony Bldg., Chicago, Ill.

RADIO and general electrical experience of a young man of 30 available on or after June first. Desire connection preferably with some large organization, shop or store intending to develop their radio and electrical trade. PW-987, Elec. World, Leader-News Bldg., Cleveland, O.

POSITIONS WANTED

RADIO man, with 4 years' experience in Navy radio laboratory, designing and testing radio apparatus, condensers, meters, etc., and 4 years as a radio operator, would like to connect with good concern. PW-16, Elec. World.

SUPERINTENDENT of construction, competent to take full charge electrical distribution, electric light, power or trolley; 25 years' practical experience; married and will go any place where living conditions are good; state salary and particulars, size of distribution, also condition same is in. PW-10, Elec. World, Real Estate Trust Bldg., Phila., Pa.

EDUCATIONAL

Bliss Electrical School

Condensed course in electrical engineering. Complete in one year. For men of character, ambition and limited time. Diploma in one year. Theoretical principles and practical applications of electricity, mathematics, steam and gas engines, mechanical drawing, extensive shop work. Construction, installation, testing. Fireproof dormitories, dining hall, laboratories, shops. 30th year begins Sept. 27th, 1922. Write for catalog. 428 Takoma Ave., Washington, D. C.

Keystone Institute

"The service school." A fully equipped school organized to give intensive instruction in 2-year courses electrical engineering, mechanical engineering, accounting and business administration, 16 weeks' course in automotive engineering. Day and night classes. Graduates sought by industrial establishments in all sections of country. Write for information on subject that interests you, to Keystone Institute. Address Associate Principal, 133 North 4th Street, Reading, Penn.

AGENTS AND SALESMEN

District Sales Representative Wanted

We are looking for a sales or industrial engineer to handle our line of electric motor control apparatus in the Philadelphia territory which includes the eastern half of Pennsylvania, southern half of New Jersey and part of Delaware. Our line is well established in the territory though a great deal of missionary work remains to be done. Position offers very good opportunity and future for man who is not looking for sinecure; compensation based on salary and bonus. AS-33, Elec. World.

Salesman

Wanted to get in touch with a first-class electrical salesman to take charge of sales in number of small towns and do house to house solicitation. This position is open in the Middle-West. AS-26, Elec. World, Old Colony Bldg., Chicago, Ill.

Wanted—Intelligent Young Man

With experience in selling phonographs to jobbers and dealers to become traveling sales and service engineer for long established firm manufacturing and distributing highest grade radio equipment. Character references required. Man of good education with some knowledge of fundamental principles of electricity preferred. Write stating age, education, experience and salary desired. AS-994, Elec. World.

Wanted—Young Man

To sell insulated wire. A knowledge of the trade would be an advantage. Write, giving full particulars, AS-21, Elec. World.

SALES REPRESENTATION

Representation in Great Britain

Electrical engineer, returning to London, is desirous of introducing one or more lines not already represented there; has wide acquaintance in engineering circles. SR-27, Elec. World.

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Electrical Engineers

With offices and showrooms in Central London are open to accept agencies for wireless sets, motors and electrical apparatus of all kinds. Colley Ltd., 51 Great Ormond Street, London, W. C. 1.

WORK WANTED

Association of Engineers

Offers services as designing or supervising engineers; electrical, mechanical, structural. WW-34, Elec. World, Real Estate Trust Bldg., Phila., Pa.

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Business for Sale

ELECTRIC wiring, fixture and supply business for sale; excellent location with long lease in city of 50,000 in western Pennsylvania; will bear fullest investigations; good reason for selling. Address BO-32, Elec. World, Leader-News Bldg., Cleveland, O.

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Turbo Generator Set

One 25 kw., 3,600 r.p.m., 125 v. non-condensing turbo generator set, completely rebuilt; f.o.b. cars Terre Haute, Ind.; price right. Write, wire or phone Power Supply Co., Terre Haute, Ind.

U. S. GOVERNMENT

PROPOSALS FOR 4 DIESEL ELECTRIC SEAGOING HOPPER DREDGES. Office Chief of Engineers, Room 2802, Munitions Bldg., Washington, D. C.—SEALED PROPOSALS will be received here until 12 o'clock noon, August 2, 1922, and then opened, for the construction of 4 Diesel Electric Seagoing Hopper Dredges. Further information on application.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 15, 1922.—SEALED PROPOSALS will be opened in this office at 3 p.m., June 29, 1922, for supplying to the various Federal Buildings, Marine Hospitals, and Quarantine Stations under the control of the Treasury Department, portable desk lamps during the fiscal year ending June 30, 1923, in accordance with the drawing and specifications, copies of which may be had at this office in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 19, 1922.—SEALED PROPOSALS will be opened in this office at 3 p.m., June 30, 1922, for supplying to the various public buildings under the control of the Treasury Department hand electric portable vacuum cleaners during the fiscal year ending June 30, 1923, in accordance with the specifications, copies of which may be had at this office in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

Federated Engineers Development Corporation
160 Ogden Ave. Jersey City, N.J.

Founded by a group of America's foremost industrial and technical experts who serve on its Advisory Council.

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Patenting an invention is but the first step toward success. Scores of worthy inventions are counted as failures because their inventors lack either the technical skill to perfect them, the business experience to market them, or the capital to develop them. We are organized to furnish the inventor with technical talent, business brains and capital sufficient to insure success.

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All insulations on attractive pound, half-pound and quarter-pound spools. Larger amounts packed on standard spools.

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Highest Standard of Excellence
Send for descriptive book

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Uniform Gauge

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Each spool carries an individual inspection number.

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Quick delivery of American Magnet Wire is assured. **Write for prices.**

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Coils made by us are unfailingly accurate in alignment because the Universal Method of winding is unfailingly exact.

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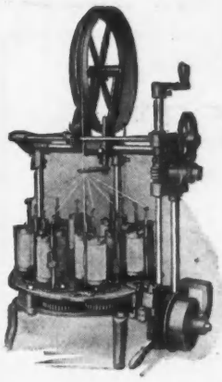
Electrical Resistance Wire

For electrical measuring instruments and resistance Units requiring extreme accuracy; Temperature coefficient nil.

The Electrical Alloy Co., Morristown, N. J.



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For Covering Wires

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Wires and Cables With Rubber or Tape

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"American Brand"
Weatherproof Wire and Cables,
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has no equal for long, satisfactory economical service.

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"AMERICAN BRAND" WEATHERPROOF WIRE AND CABLES HAS NO EQUAL

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DUDLO *Magnet Wire and Windings*

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have for over twelve years been standard among electrical manufacturers due to their dependable quality and reasonable price. Find out the economy and improvement we can effect for you.

Write today for prices and samples.

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Blake Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for Samples.

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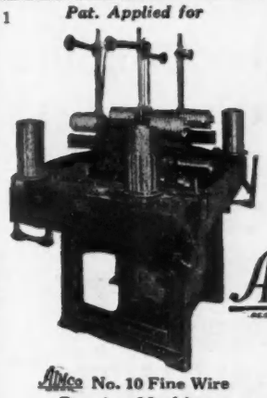

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OCCUPY LEAST FLOOR SPACE
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Measuring	Enameling	Taping
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COPPERWELD Wire—*Made by the Molten Welding Process.*
Bare—Weatherproof—Strand—Twisted Pair—Nails.

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Insulated Wire-Cord and Cables

For all Electrical Purposes

PHILADELPHIA INSULATED WIRE CO.
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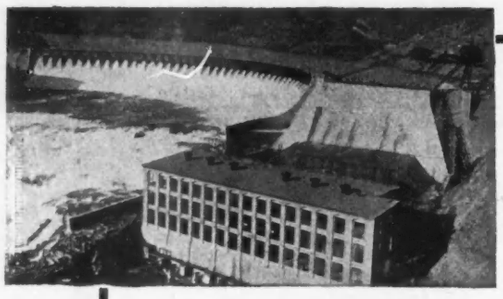
SAMSON SPOT CORD

FOR HANGING ARC LAMPS
SOLID BRAIDED COTTON—WATER PROOFED
Send for Catalogue and Samples.
SAMSON CORDAGE WORKS, BOSTON, MASS.



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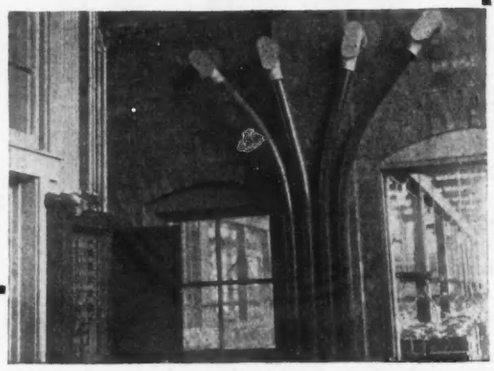
Is the Conduit to Use in Moisture and Acid Laden Air

Around hydro-electric power stations or in sections of the country where the atmosphere is moisture laden—"Sherarduct" should protect your current carrying wires and cables. "Sherarduct" is rust proof inside and outside. This is an important feature because it often becomes necessary to replace wires—and if the interior of the conduit is rusted, IT CAN'T BE DONE.

While sherardizing alone is absolute protection against RUST—"Sherarduct" is further protected inside and outside by an alkali proof and acid proof enamel baked on to make it the logical and economical conduit to use for battery rooms and in cinders or cinder fill concrete.

Sherarduct is the only rigid steel conduit that is both RUST PROOF and ACID PROOF inside and outside.



National Metal Molding Co.

Pittsburgh, Pa.

American Fibre Conduit Corporation

Manufacturers of

"AMERICAN"

FIBRE CONDUIT

FOR

Underground Electric Systems

American Fibre Conduit is of homogeneous construction, light, strong and compact. It is made in two types of joint, the mortise and tenon or Socket Joint, and tapered sleeve or "American" Harrington Joint, with Bends, Elbows and Fittings. It will stand the most rigid tests.

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HARD PORCELAIN

For Electrical Specialties

IMPERIAL PORCELAIN WORKS

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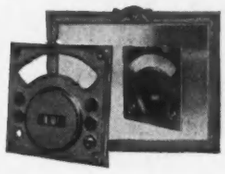

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Experience in cold molding from 1908 to 1921 will solve your problems.

Let us prove it.

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STERLING VARNISH

Manufactured by electrical engineers who will understand your insulating problems and render intelligent service. Noted for uniformity and quality. It will pay you to get in touch with

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BAKELITE–CONDENSITE–ROXITE

Machine Moulding of Small Parts a Specialty

Prompt Deliveries.

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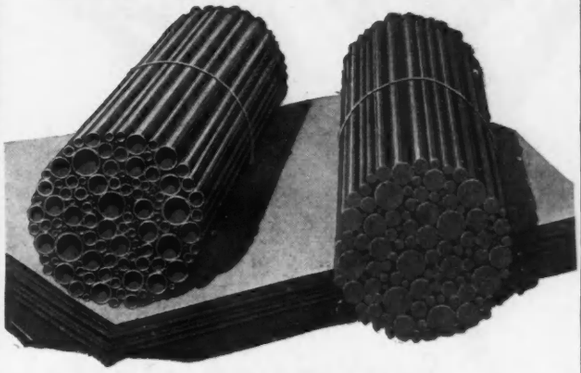
Make it of VUL-COT Fibre



Uniform

and free from grit or other foreign substance

Many persons have remarked upon the uniformity of

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(Sheets, rods and tubes, or machined to your specifications)

There's really no secret about this. It's the result of the supervision we are able to maintain in *VUL-COT* Fibre's Making.

We Make Our Own Paper

The rags used in this paper making are inspected, sorted, dusted and cut in our plant. Then, in the same building, we make them into the paper which we use in *Vul-Cot* Fibre—many tons of it daily.

Here are just a few places in the electrical manufacturing field where you'll find it to your advantage to use *Vul-Cot* Fibre:

Armature Wedges
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AMERICAN VULCANIZED FIBRE CO

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Complete Stock for Immediate Shipment at Chicago

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for certain vital factors of electrical construction

(*Radio Particularly*)

there is absolutely no substance with the peculiar merits of

bakelite -dilecto!!

Supreme in insulative efficacy; amazingly hard and tough, yet readily machined; insoluble in water of the weaker acids; cannot swell or warp; and has tremendous dielectric and tensile strength.

Dealers in RADIO SUPPPLIES are urged to get in early on powerful advertising effort now begun by

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FOR ELECTRICAL AND MECHANICAL PURPOSE

INDIA — AMBER — DOMESTIC

Any size, shape, pattern, grade, rough trimmed, rectangular cut, washers, discs, rings, cones, tubes, etc. For every use of mica we are prepared to submit samples and prices of qualities best suited to requirement. We can "show you." WRITE!

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2

PLATINUM PLATINUM

BAKER MANGANIN

PROPERTIES

Melting Point, 910°C.
Specific Gravity, 8.4
Brinell Hardness:— Hard worked, 179 Annealed, 123
Resistance at 15° C. is approximately 300 ohms per mil. ft.
Temperature Coefficient of resistance between 15° and 30° C. is less than .00001 per °C.
Electromotive Force against Copper is 1.4 microvolts per °C.

Literature and quotations on request.

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FOR ELECTRICAL APPARATUS—Silicon Alloy Steel (Hadfield Pats.)
APOLLO Special Electrical, Dynamo Special, Motor Special, U. S. Electrical, American Armature, Pole Steel, Rotor Steel, Etc. Write for full information.

AMERICAN SHEET AND TIN PLATE COMPANY, Frick Building, Pittsburgh, Pa.

VULCANIZED FIBRE

Be Sure to Specify

"Wilmington Fibre"

Sheets Rods Tubes
Special Shapes for Insulation Purposes
"FYBEROID"

Wilmington Fibre Specialty Company

Wilmington, Del. Branch Offices "Everywhere"

STANDARD

Wires, Cables, Cable Accessories
Superior quality, economical prices
Standard Underground Cable Co.
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New York Washington Chicago St. Louis
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There are reasons why

LAVA insulation is so often specified by the manufacturers of highest quality instruments and appliances.

Ask for Kruesi's Book

AMERICAN LAVA CORPORATION

1419 William St., Chattanooga, Tennessee

The Value of an Insulator

is not in the glaze. It must be good all through
THOMAS INSULATORS
are 100% good

THE R. THOMAS & SONS CO., East Liverpool, Ohio
Factories, East Liverpool and Lisbon, Ohio; sales offices, New York, Boston and Chicago

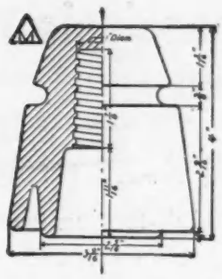
Install the "Franklin" and forget it!

"FRANKLIN"

Bus Bar Supports, Disconnecting Switches, Potheads and other specialties for power station work give the most value for the money invested.

Electrical Development & Machine Company
PHILADELPHIA

Porcelain Insulators

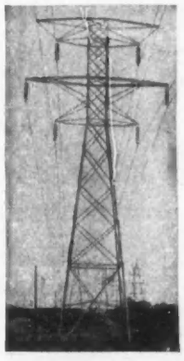


Above is our No. 224 Insulator for Long Distance Telephone lines or Power Service up to 3300 volts.

We are prepared to manufacture Insulators for any voltage by the most modern plastic method and give them the most rigid mechanical inspection and electrical tests.

We guarantee every Insulator to be at least equal to any insulator of similar design on the market.

Illinois Electric Porcelain Co.
Macomb, Ill.



LOCKE INSULATORS

The character and reputation of an insulator should be verified before entrusting to it the important task of guarding the transmission of electrical energy. *Ask for Locke Insulator data.*

Locke Insulator Corporation, Victor, N. Y.

Over a quarter of a century manufacturers of electrical porcelain for high tension electrical power transmission.

Factories: Victor, N. Y. and Baltimore, Md.

PORCELAIN INSULATORS

for in the station and on the line

TIME IS THE TEST

The OHIO BRASS Co., Mansfield, Ohio

RUGGED DISC INSULATORS

"PROTECT WITH JD TO A GREATER DEGREE."

JEFFERY-DEWITT INSULATOR CO. KENOVA, W. VA. U.S.A.

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HIGH TENSION
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No. 64 for Joint Insulation
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STEEL STRUCTURES
for
Transmission Lines
To Meet Every Requirement

Transmission Towers	Switching Towers
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We have been galvanizing steel towers for nearly 30 years and those first towers still stand as proof of the wonderful quality of our galvanizing.

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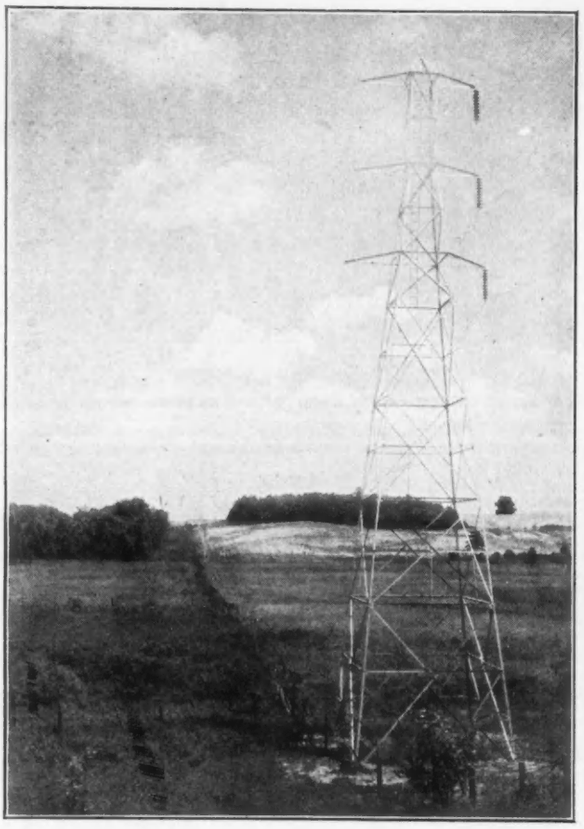

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suitable for every service requirement.
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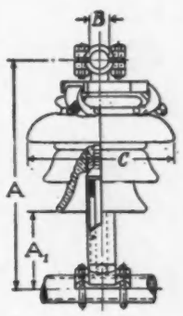

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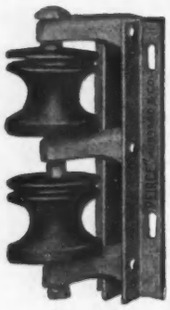
For Vertical Secondary Distribution



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Low First Cost.

The first cost of Peirce Secondary Racks complete with insulators is less than a good grade of wood cross arms complete with pins and insulators.

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To mount a Peirce Secondary Rack on a pole, it requires boring one hole for a through bolt and driving one lag screw. No gains to cut—no arms to pin or handle—no cross arm braces to assemble.

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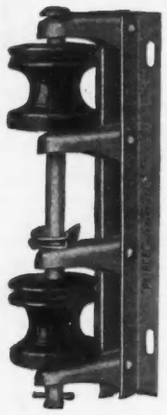
Peirce Secondary Racks are made of open hearth steel, galvanized by the double hot dip process. They out-live the poles on which they are mounted.



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APPROVED

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2. Furnished with *approved* soldering lugs.
3. Equally good for soldered or solder less connections.
4. Adjustable—three sizes covering all requirements.
5. Easiest and quickest to apply.
6. A screw-driver only necessary.

"None are as good—few are as cheap"

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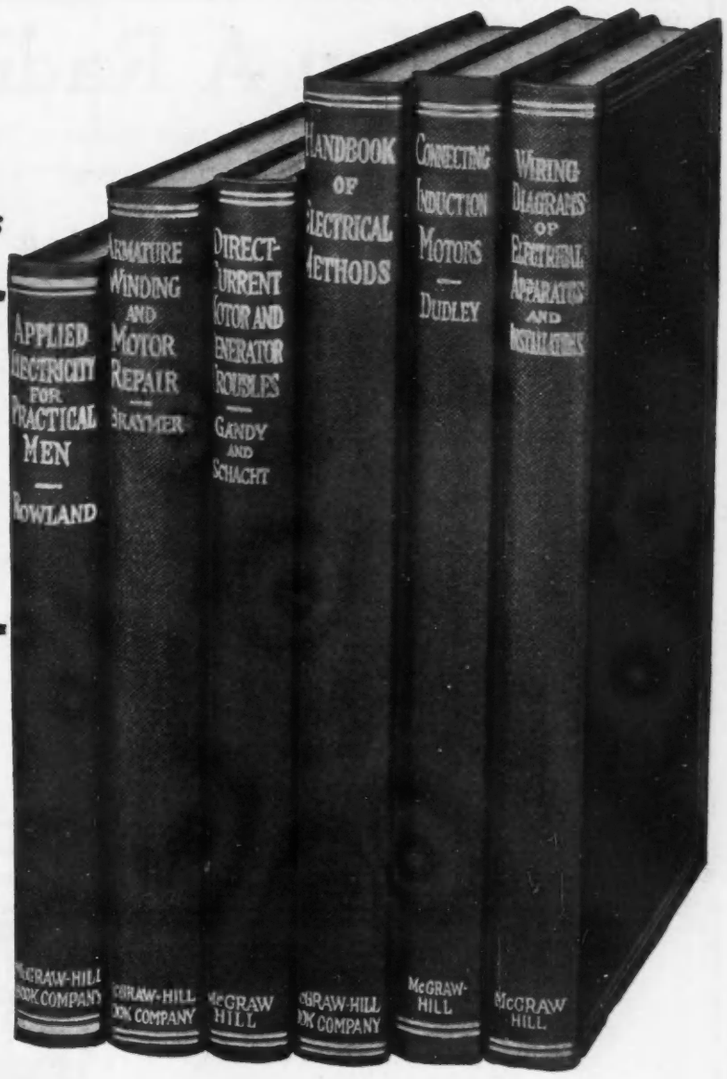

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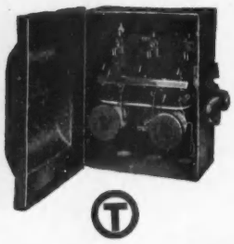

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control level of liquids in any locations

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For Switchboards, circuit breakers, compensators and similar electrical equipment Monson Slate is recognized as the best.

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Use "Three-E" Products for their built-in *quality* and *superior design*. We are specialists in High Tension Equipment
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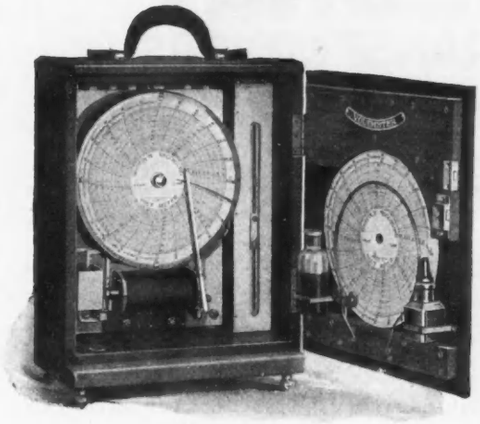

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It contains considerable information that should prove helpful to every engineer who is interested in the subject of *insulation resistance*—with respect to generators, motors, transformers, switchboards, insulators, cables, interior wiring, etc.

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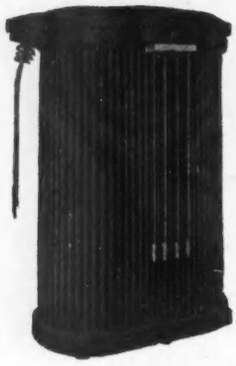

give unusual results to their owners.

Moloney Transformer

users pay less for repairs. They enjoy more continuous and more consistent service from their transformers.

These advantages go straight back to the fine engineering, high class workmanship and excellent materials which make the MOLONEY TRANSFORMER a different kind of a transformer.

They are the heart and soul of contentment which is so typical of MOLONEY TRANSFORMER users.

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Five feet of connecting wire furnished welded to the ground—nothing but pure continuous copper used underground.

No destruction of connections from galvanic or electrolytic action possible and nothing better than this pure copper to resist corrosion and deterioration.

Absolutely solve the problem of grounding efficiently and cheaply.

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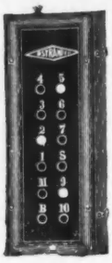
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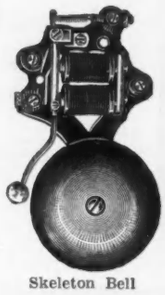
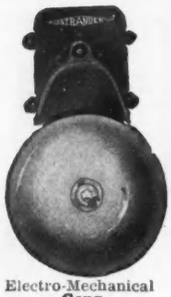

Skeleton Bell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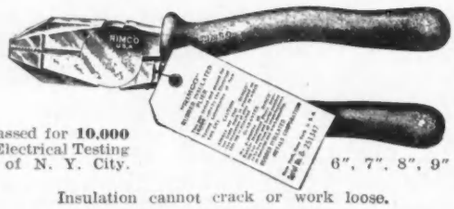

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Insulation cannot crack or work loose.

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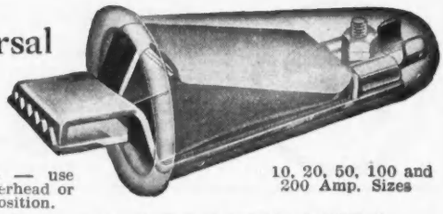

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NITROGEN WHITELITE LAMPS

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Licensed under General Electric Company's Patents

225 to 230 Candle Power

vs.

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The Bureau of Standards has an established rating for incandescent electric lamps. For 200 watts it is 225 C.P.

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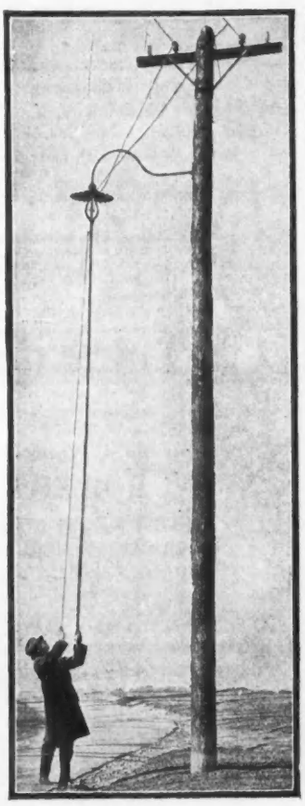
Now in 40, 60, 75, 100 and 200 Watts

The Dualite is fully protected by U. S. Patents, and is made and controlled exclusively by us.

The Superior Gas Filled Lamp with One Filament

WHITELITE



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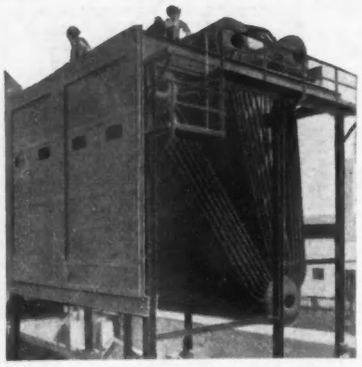

This picture shows a 1058-H.P. unit at Andrews Steel Co., Newport, Ky.

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is so designed as to extract the most heat from the fuel, to provide for expansion and contraction, to eliminate to the highest possible degree all unnecessary joints, to entirely eliminate the use of staybolts, braces and crown bars. It is built in the most modern and best equipped boiler manufacturing plant in America, by a firm representing 46 years of experience with the result of having a mechanism that gives the highest daily efficiency of operation.

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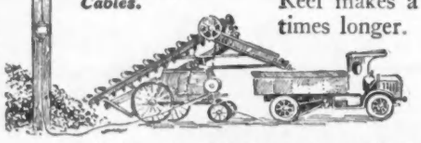

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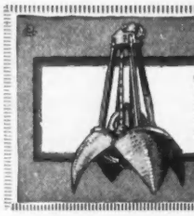

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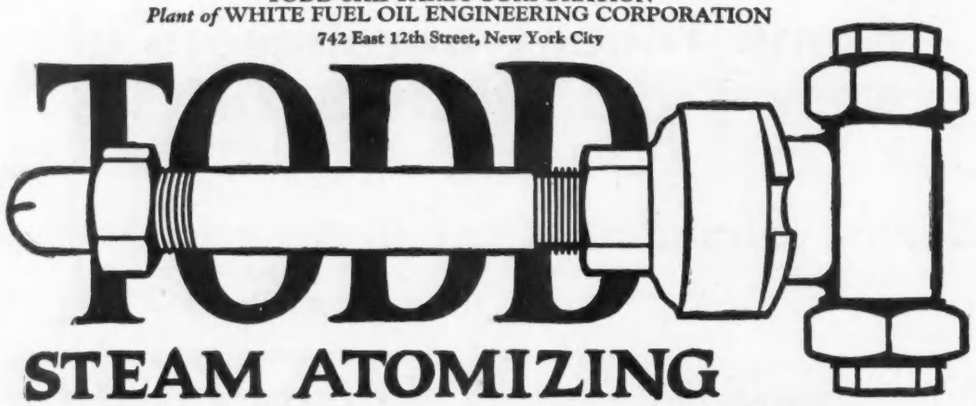

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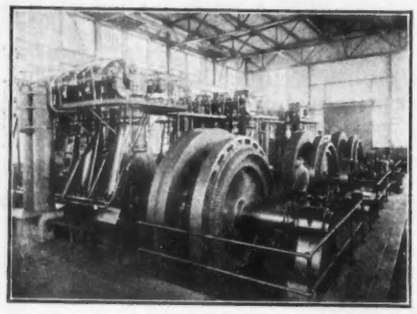

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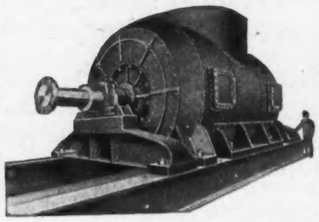

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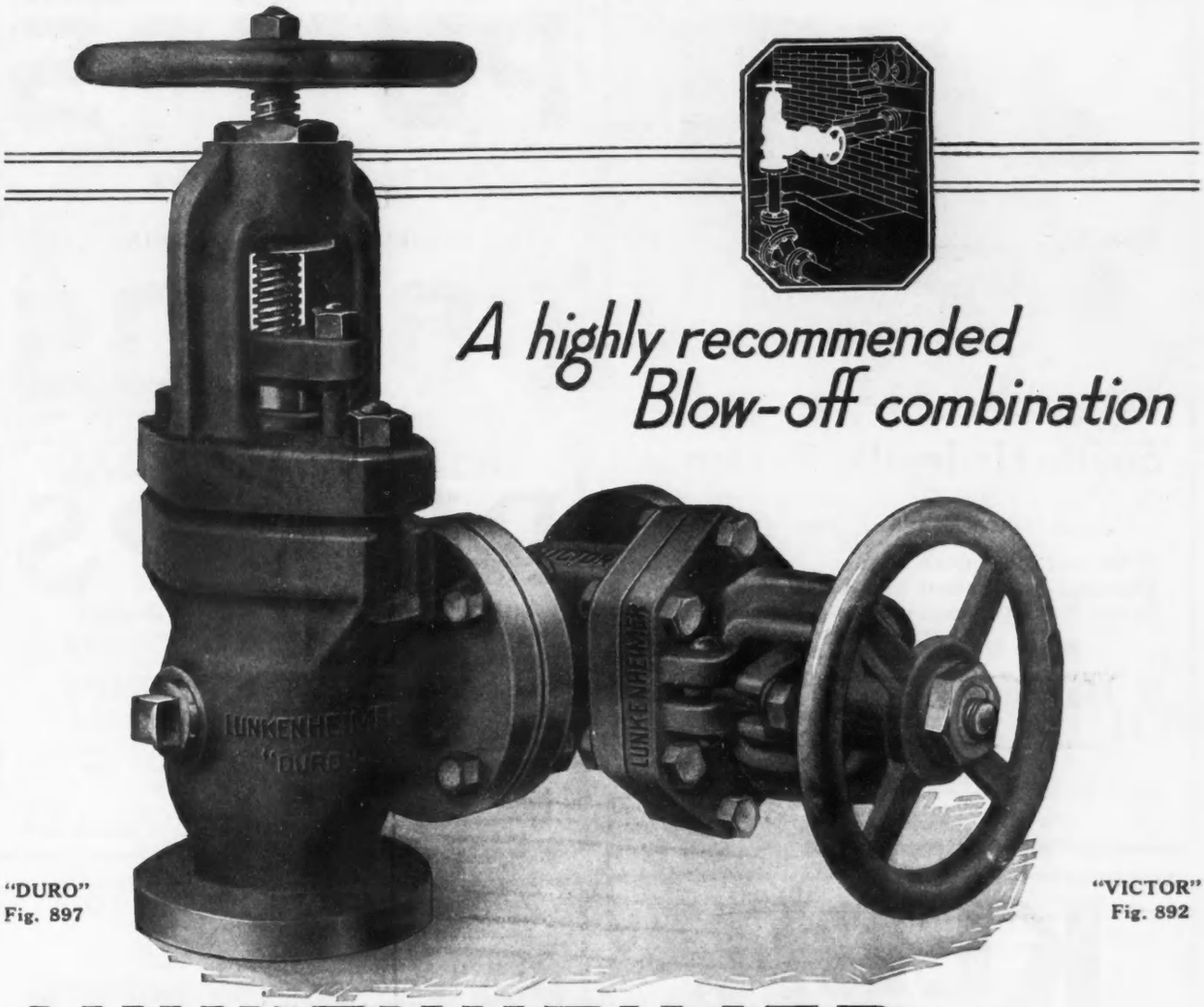

A highly recommended Blow-off combination

"DURO" Fig. 897

"VICTOR" Fig. 892

LUNKENHEIMER *Blow-off Valves*

remain tight in service, prevent waste through boiler blow-off lines, and thereby turn to a profit the losses caused by leakage which frequently occurs at this point.

In Lunkenheimer Blow-off Valves the water is released gradually due to the peculiar construction of the seat and disc. This virtually makes them safety devices since they eliminate the dangers incident to undue agitation within the boiler or severe shock in the discharge line which result when blow-off Valves are opened suddenly.

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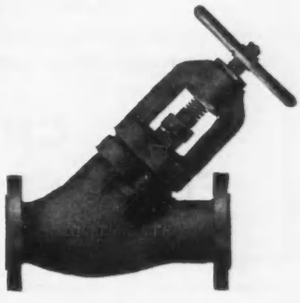

Fig. 1352
Straightway or Y Pattern

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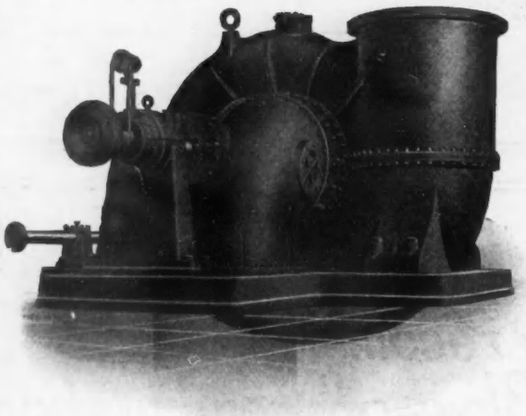

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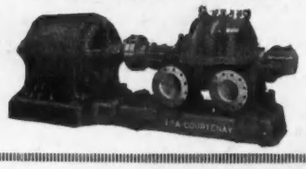

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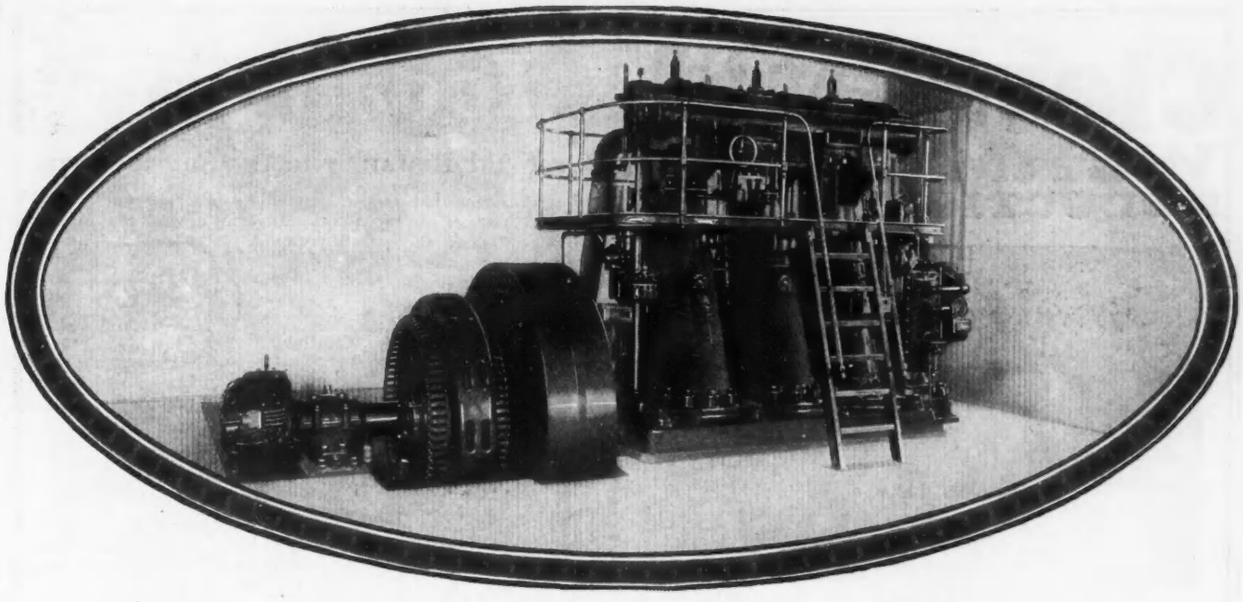

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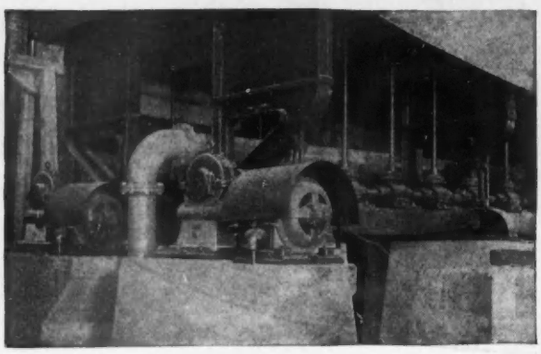
WORM GEAR REDUCTION UNITS



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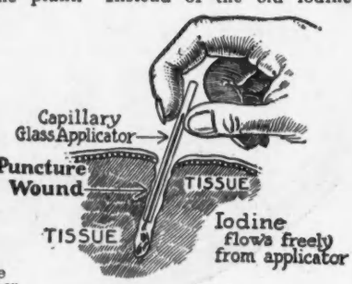

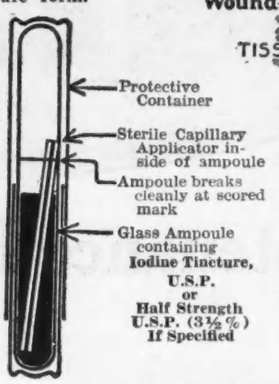
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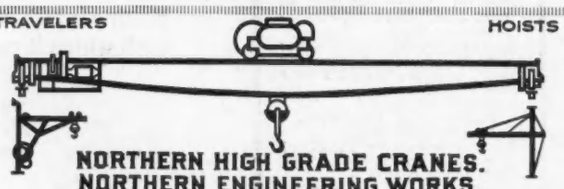

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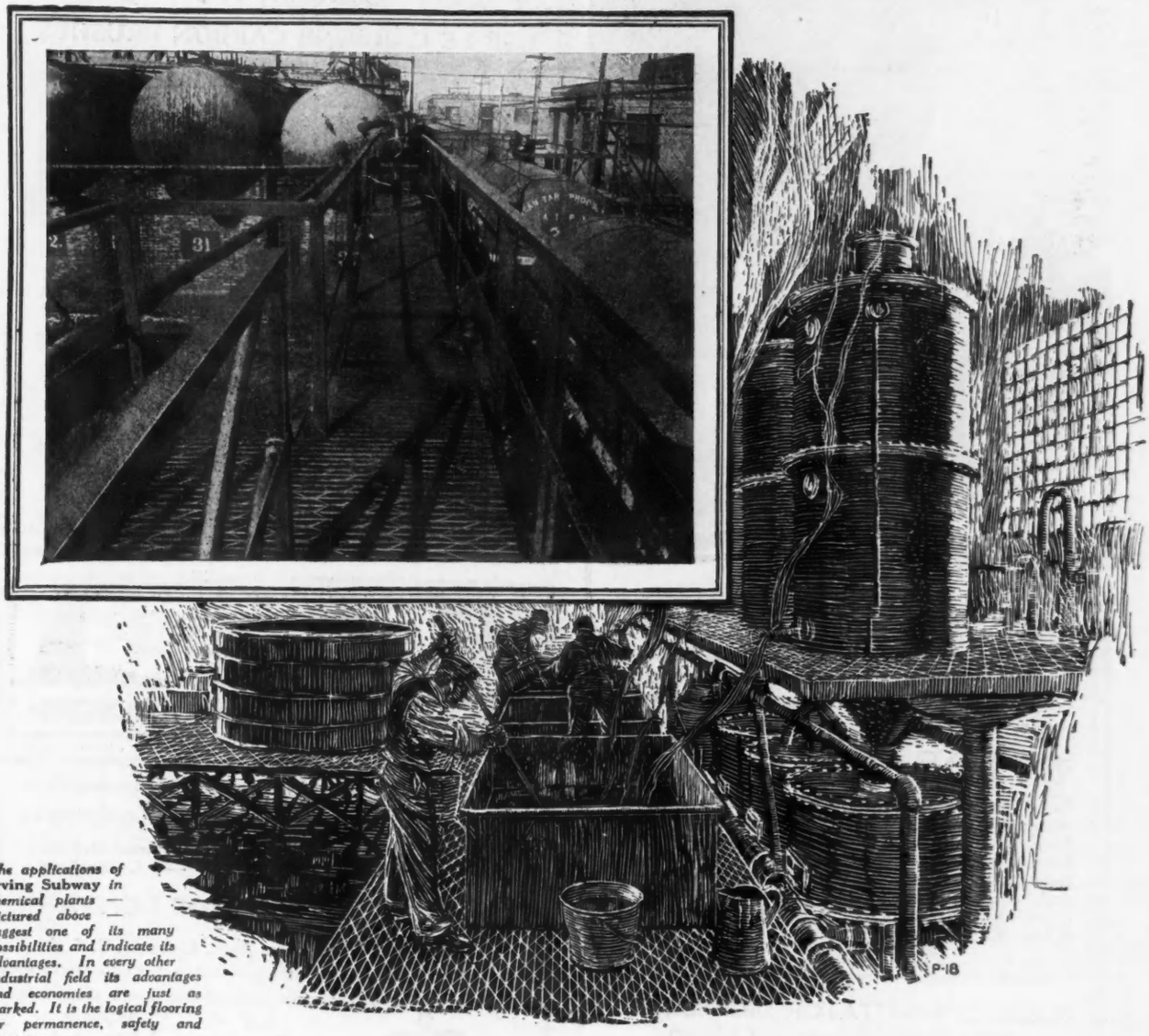

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The best thing about the Ideal Commutator Resurfacer is the *ease* and *speed* with which you can grind out the high spots that cause power loss.

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Since you can resurface commutators in a jiffy, and without shutting down motors or generators, you *keep* equipment *always* at highest efficiency. The Ideal in not a natural stone. Its cutting properties are constructed uniform. It won't fill up, wear smooth, and, being non-metallic, won't cause "shorts." Always takes hold the minute it's applied. Costs less because it lasts longer.

The Ideal must make good before it costs you one cent. The liberal offer below is surely worth immediate attention.

IDEAL COMMUTATOR DRESSER CO.
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Send Coupon E.W. 6-24-22

IDEAL COMMUTATOR DRESSER CO.
3221 Sheffield Avenue, Chicago

Gentlemen: Please send me an Ideal Commutator Resurfacer for free trial. If I like it I'll pay for it. If I don't like it, I will return it—the trial will have cost me nothing. I want to use it on equipment with approximate r. p. m., width, diameter and clearance as follows:

Approx. R. P. M.....Diameter of Commutator or Ring.....
Approx. width of Commutator or Ring surface.....
Approx. distance between brush sets.....Condition.....
Collector Ring or Commutator Material.....
Position.....
My name is.....Company address.....
Company.....State.....
City.....

You're having brush trouble

CORRECT IT

USE LE CARBONE CARBON BRUSHES

They talk for themselves

COST MORE PER BRUSH
COST LESS PER KW.H.

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Pittsburgh Office: 634 Wabash Bldg.
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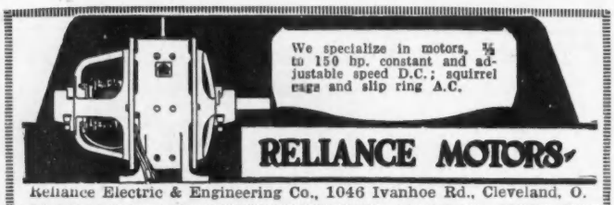

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Alternating Current Equipment

Variable Speed Single Phase Motors
Fans — Blowers — Controllers

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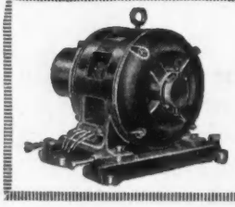

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D.C. ball-bearing motors, 1/6 hp., 700 r.p.m. to 40 hp., 1750 r.p.m. A.C. ball-bearing motors up to 40 hp.; also generators, alternators, and motor generators in horizontal and vertical types. We build motors to meet your requirements. *Ask us for more data.*

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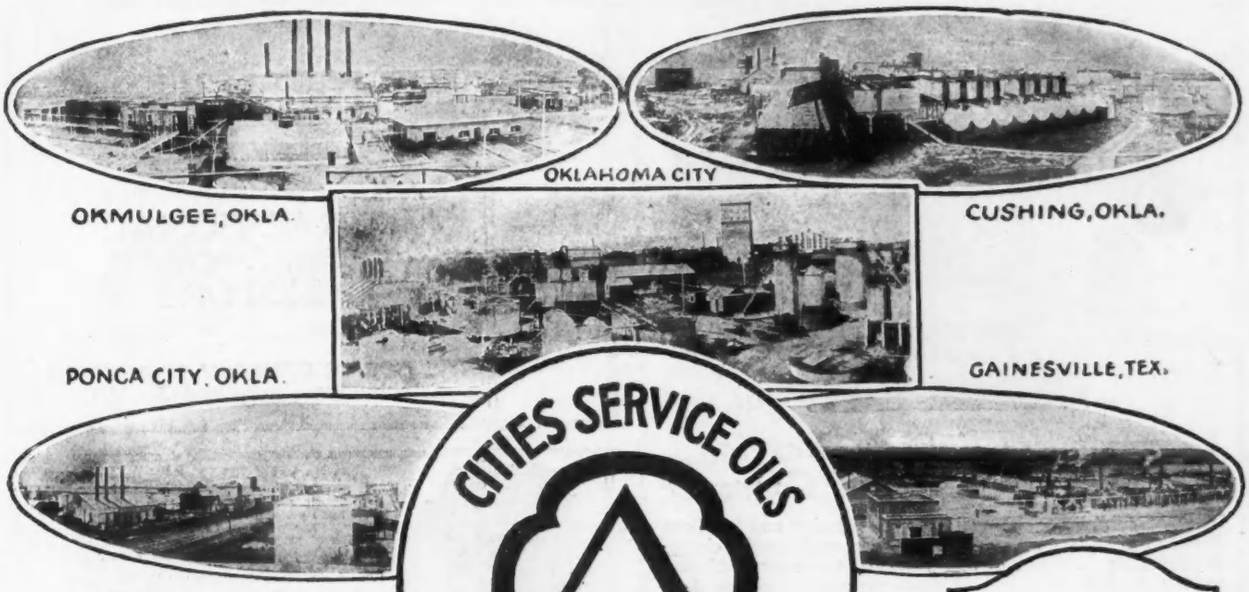

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FUEL OIL that can be stored more conveniently.
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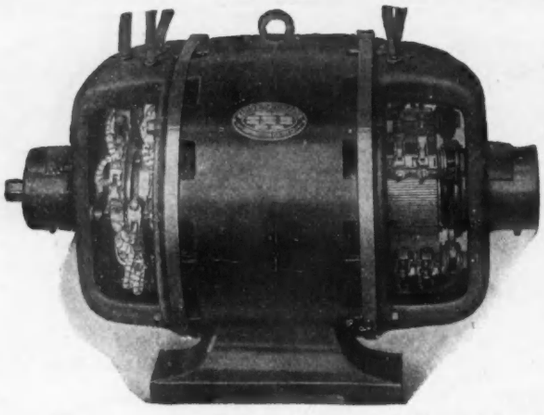

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The ease with which these converters can be started and operated recommends their use in a variety of installations. They are as simple to start as a motor and require about the same attention in the matter of oiling and care.

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FRACTIONAL HORSE-POWER MOTORS

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When Quiet Operation is required

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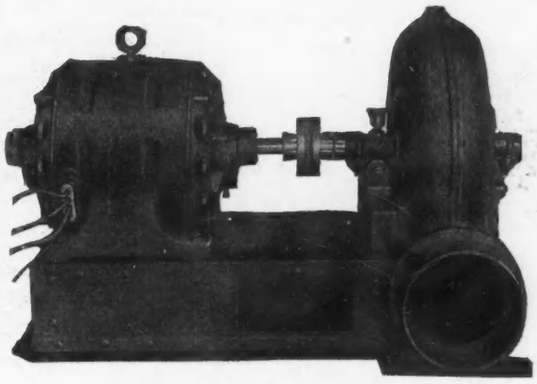

Five horsepower motor direct connected to a pressure blower

Repulsion Start Induction Single Phase Motors

Their construction and design are such as to reduce to a minimum the inherent magnetic humming and vibrations, not only while starting, but also while running under full load. This fact makes them very desirable for operating such apparatus as church organ blowers, vacuum cleaners, refrigerating machines, heating and ventilating fans for public buildings, etc.

Ratings ⅛ to 40 H. P.

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Manufacturers of
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Constant or Variable Speed ¼ to 50 HP.
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When you need power put a Valley Motor on the job.

It will deliver now—and many years from now. Valley Motors are built to last, are all ball-bearing, all 40° rise and best ventilated. Sizes from 1-2 to 30 h. p.

When you write ask for Bulletin 7.

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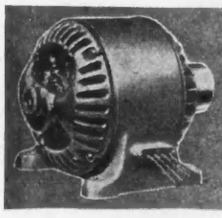
Valley Motors



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MOTORS AND GENERATORS
SATISFACTION to every USER
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Builders of Direct Current Ball Bearing Commutating Pole Motors of ½ H.P. to 60 H.P. at Induction Motor Speeds.
Bulletin 200 contains complete information.
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Built to a Standard

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Equipment, Apparatus and Supplies Advertised in this Issue with Names of Manufacturers and Distributors

Readers interested in any articles not listed in these pages are cordially invited to inform us of their wants and every effort will be made to put them in touch with the proper manufacturers.

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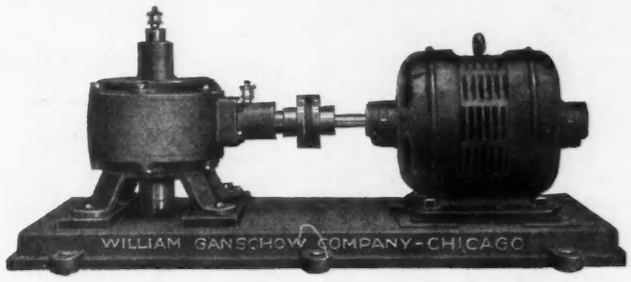

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This method of transmitting power from motor to machine is done without pulleys, belts, chains, gears or shafts or the need of attention that other forms of reduction require.

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Ganschow Speed Transformers are made in several designs and sizes, for reductions as high as 250 to 1 and from ½ to 100 H.P.

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Chicago, Illinois

Ganschow Direct Drive Speed Reducer

The Ganschow Right-Angle Speed Transformer—one of our several models

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Noetling & Betz

Irons, Electric
Electrical Dev. & Mach. Co.
Westinghouse Elec. & Mfg. Co.

Laboratories
Electrical Testing Laboratories

Lamp Replacers
G.C.A. Mfg. Co.

Lamps,
Arc
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Carbon
Sunlight Elec'l Mfg. Co.
Incandescent
Consolidated Electric Lamp Co.
General Electric Co.
Western Electric Co.
Whitelite Electric Co.
Miniature, Inc.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lightning Arresters
Delta Star Electric Co.
Elec. Power Equip. Corp.
Electric Service Supplies Co.
Electrical Engineers Equip. Co.
Electro Service Co.
General Electric Co.
Hubbard & Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Line Material
Archbold-Brady Co.
Electric Service Supplies Co.
G. & W. Elec. Spec. Co.
General Electric Co.
Hubbard & Co.
Johns-Manville, Inc.
Ohio Brass Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Linemen's Supplies and Tools
Klein & Sons, Mathias

Loaders, Coal
Gifford-Wood Co.

Lubricators, Hydrostatic Mechanical
Lunkenheimer Company

Lugs
Sherman Mfg. Co., H. B.

Machines
Armature Notching
Ferracute Machine Co.

Magnesia, Heat Insulation
Johns-Manville, Inc.

Magnets
Coto-Coil Co.
Dudlo Mfg. Co.
Cutler-Hammer Mfg. Co.
I. R. Nelson Company

Magnets, Lifting
Cutler-Hammer Mfg. Co.

Manganin
Baker & Co., Inc.

Meter Testers
Baker & Co., Inc.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Meters, Flow
(See Instruments, Electric and Boiler Room)

Mica
Munsell, Eugene

Mining Machinery
Allis-Chalmers Mfg. Co.

Molded Insulation (See Insulation, Molded)

Molded Parts
Belden Mfg. Co.
Condensite Co. of America
Redmanol Chem. Prod. Co.

Molding Metal
National Metal Molding Co.

Motors
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Allis-Chalmers Mfg. Co.
Baldor Electric Co.
Bodine Elec. Co.
Burke Elec. Co.
Century Electric Co.
Colonial Fan & Motor Co.
Crawford Mfg. Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Electric Machy Mfg. Co.
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Fairbanks, Morse & Co.
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Peerless Electric Co.
Robbins & Myers Co.
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Sturtevant Co., B. F.
Valley Electric Co.
Wagner Elec. Mfg. Co.
Wesche Electric Co., B. A.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

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Burke Elec. Co.
Valley Electric Co.

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Spray Engrg. Co.

Office Space
Philadelphia Evening Bulletin

Oil Burners
Todd Shipyards Corp.

Oil Engines (See Engines)

Oils
Fuel
Empire Refineries, Inc.
Lubricating
Empire Refineries, Inc.

Packing
Johns-Manville, Inc.

Panel Boards
Adam Electric Co., Frank
General Electric Co.
Trumbull Vanderpool Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Panels, Switchboard
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Photometric Apparatus
Electrical Testing Laboratories
Leeds & Northrup Co.

Pipe Coils
Superheater Co.
Copper Heating Tubing
Chase Metal Works

Pipe Fittings
Crane Co.

Pipe Frame Fittings, Electrical
Schweitzer & Conrad, Inc.

Pipe (Riveted Steel)
Riter-Conley Mfg. Co.
Brass
Chase Metal Works

Platinum
Baker & Co., Inc.

Pliers (Rubber Insulated)
Rubber Insulated Metals Corp.

Plugs, Attachment
General Electric Co.
Westinghouse Elec. Mfg. Co.

Plugs
Delta Star Electric Co.
General Electric Co.
National Metal Molding Co.
Westinghouse Elec. Mfg. Co.

Pole Line Hardware
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Western Elec. Co.

Poles
Iron
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Milliken Bros. Mfg. Co.
Steel
Aermotor Co.
Pacific Coast Steel Co.
Wood
Bell Lumber Co.
Bruce Co., M. L.
Hubbard & Co.
Naugle Pole & Tie Co.
Partridge Lumber Co., T. M.
Western Elec. Co.

Poles, Reinforcing of
Hubbard & Co.

Posts
Wood
Naugle Pole & Tie Co.

Potentiometers
Biddle, James G.
General Electric Co.
Leeds & Northrup Co.
Westinghouse Elec. Mfg. Co.

Potheads
Elec'l Development & Machine Co.
G. & W. Elec. Spec. Co.
Johns-Manville, Inc.

Presses Cutting
Ferracute Machine Co.

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Electric Service Supplies Co.

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Schweitzer & Conrad, Inc.
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Rockwood Mfg. Co.

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Combustion Engineering Co.

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Centrifugal
Allis-Chalmers Mfg. Co.
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Fairbanks, Morse & Co.
Goulds Mfg. Co.
Lea-Courtenay Co.
Manistee Iron Works
Terry Steam Turbine Co.
Power
Lea Courtenay Co.
Reciprocating
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
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Pyrometers
Bristol Co., The
Leeds & Northrup Co.
Taylor Instrument Co.

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Westinghouse Elec. & Mfg. Co.

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Ohio Brass Co.

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Bonstead Elec. & Mfg. Co.
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I. R. Nelson Company

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Electrical Alloy Co.

Resistance Units
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Industrial Controller Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Rheostats
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General Electric Co.
Sundh Electric Co.
Valley Electric Co.
Westinghouse Elec. & Mfg. Co.
Miscellaneous
Ward Leonard Elec. Co.
Motor Speed Regulating
Ward Leonard Elec. Co.
Starting and Controlling
Ward Leonard Elec. Co.

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Rome Brass & Copper Co

Rods, Brass, Copper and Bronze
American Brass Co.
Chase Metal Works
Rome Brass & Copper Co.

Rolls, Brass, Copper and Bronze
Chase Metal Works
Rome Brass & Copper Co.

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Screwdrivers (Rubber Insulated)
Rubber Insulated Metals Corp.

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Westinghouse Elec. Mfg. Co.

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Coleman & Shoemaker
Commonwealth Edison Co.
Davis, J. F.
Davis Machine & Motor Co., Inc.

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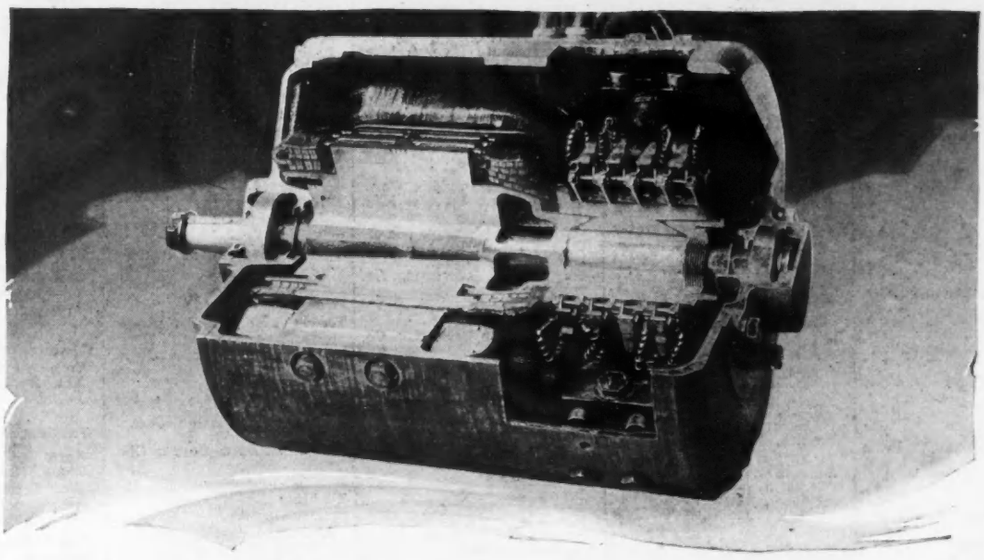

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Other advantages which play an important part in motor performances are the elimination of frictional wear with resultant possibility of stripped armatures, and the exclusion of dust and grit from the bearings. Write for engineering details.

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Supervised by SKF INDUSTRIES, INC., 165 Broadway, New York City

780

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Hemphill & Co., J. L.
Independent Elec. Mchy. Co.
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MacGovern & Co.
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Miller Owen Elec. Co.
Miller Seldon Elec. Co.
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Newark Elec. Repair Co.
Nussbaum Co., V. M.
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Randle Machy. Co.
Ross Power Equip. Co.
Scheinert & Co., R.
Stewart Elec. Co., John A.
Stewart & Co., Paul
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Wickes Mchy. Co.
Willey Wray Elec. Co.

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Elliott Company
Steam
Elliott Co.

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Ostrander & Co., W. R.

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Rome Brass & Copper Co.
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Lupton's Sons Co., David

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Maxim Silencer Co.

Silent Chain Drive
Morse Chain Co.

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Ostrander & Co., W. R.
Westinghouse Elec. & Mfg. Co.

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Mitchell-Rand Mfg. Co.

Soldering Flux
Blake Signal & Mfg. Co.
Mitchell-Rand Mfg. Co.

Soldering Irons
Cutler-Hammer Mfg. Co.

Solenoids, (see Coils)

Speed Reducers
Ganschow Co., Wm.

Sprockets, Silent Chain
Morse Chain Co.

Staples
Blake Signal & Mfg. Co.

Starters, Motor Electric
Condit Elec'l Mfg. Co.
General Electric Co.
Industrial Controller Co.
Sundh Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Steam Insulation
Johns-Manville, Inc.

Steam Specialties
Lunkenheimer Company
Power Specialty Co.

Steel, Structural
Pacific Coast Steel Co.

Stokers
Babcock & Wilcox Co.
Combustion Eng'g Co.
General Elec. Co.
Riley Stoker Co., Sanford
Westinghouse Elec. & Mfg. Co.
Mechanical
American Engineering Co.

Stokers, Pulverized Coal
Combustion Engineering Co.

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Elliott Co.
Water
Elliott Co.

Structural Steel
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Aermotor Co.
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Elec. Power Equip. Corp.
Elec. Engineers Equip. Co.
Electro Service Co.
General Electric Co.
Memco Engr. & Mfg. Co.
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Westinghouse Elec. & Mfg. Co.

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Babcock & Wilcox Co.
Power Specialty Co.
Superheater Co.

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General Electric Co.
Johns-Manville, Inc.
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Western Electric Co.
Westinghouse Elec. & Mfg. Co.

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Western Electric Co.
Westinghouse Elec. & Mfg. Co.

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Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

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Roller-Smith Co.
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Wagner Elec. Mfg. Co.
Western Elec. Co.
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Elec'l Engineers Equip. Co.
General Electric Co.
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Sundh Elec. Co.
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Hi-Voltage Equipment Co.
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Trumbull Vanderpoel Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.
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General Electric Co.
Westinghouse Elec. & Mfg. Co.
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Payne Deane, Ltd.
Railway & Industrial Eng. Co.
Sundh Elec. Co.
Westinghouse Elec. & Mfg. Co.
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Johns-Manville, Inc.
Square D Company
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Trumbull Vanderpoel Electric Mfg. Co.
Wadsworth Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
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General Electric Co.
Westinghouse Elec. Mfg. Co.
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General Electric Co.
Western Electric Co.
Westinghouse Elec. Mfg. Co.
Time
Anderson Mfg. Co., A. & J. M.
General Electric Co.
Paragon Electric Co.
Westinghouse Elec. & Mfg. Co.

Synchroscopes
Bristol Co., The
General Electric Co.
Roller Smith Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Inst. Co.

Tachometers
Biddle, James G.
Bristol Co., The
Foxboro Co.
Johns-Manville, Inc.
Roller-Smith Co.

Tanks
Riter-Conley Mfg. Co.

Telephones
Western Elec. Co.

Testing Apparatus
American Transformer Co.
Biddle, James G.
General Electric Co.
Leeds & Northrup Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

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Electrical Testing Laboratories

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General Electric Co.
Industrial Controller Co.
Westinghouse Elec. Mfg. Co.

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Bristol Co., The
Foxboro Co.

Tie Bands
Copper Clad Steel Co.

Ties
Naugle Pole & Tie Co.

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Tools
Construction
Klein & Sons, Mathias
Oshkosh Mfg. Co.
Underground Conduit
Railway & Industrial Eng. Co.

Towers
Radio
Milliken Bros. Mfg. Co., Inc.
Pacific Coast Steel Co.
Transmission
Aermotor Co.
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Milliken Bros. Mfg. Co. Inc.
Pacific Coast Steel Co.
Railway & Industrial Eng. Co.
Riter-Conley Mfg. Co.

Transformers
Allis-Chalmers Mfg. Co.
American Transformer Co.
General Electric Co.
Kuhlman Electric Co.
I. R. Nelson Company
Moloney Electric Co.
Packard Electric Co.
Pittsburgh Transformer Co.
Wagner Elec. Mfg. Co.
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General Elec. Co.
Packard Electric Co.
Westinghouse Elec. & Mfg. Co.

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Morse Chain Co.

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Irving Iron Works Co.

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Brass, Copper and Bronze
Chase Metal Works
Rome Brass & Copper Co.

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Hydraulic
Allis-Chalmers Mfg. Co.
Leffel & Co., James
Smith Co., S. Morgan
Steam
Allis-Chalmers Mfg. Co.
De Laval Steam Turbine Co.
General Electric Co.
Kerr Turbine Co.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.

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Allis-Chalmers Mfg. Co.
General Electric Co.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.

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Lunkenheimer Company
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Gate
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Lunkenheimer Co.
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Allis-Chalmers Mfg. Co.

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Woodward Governor Co.

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Ohio Brass Co.
Rail Joint
Ohio Brass Co.

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General Electric Co.
Westinghouse Elec. & Mfg. Co.

Welding Machines
General Electric Co.
Ohio Brass Co.
Westinghouse Elec. & Mfg. Co.

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New England Butt Co.

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Rome Wire Co.
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American Ins. Wire & Cable Co.
Amer. Steel & Wire Co.
Anaconda Copper Mining Co.
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Rome Wire Co.
Brass and Bronze
Chase Metal Works
Copper Clad
Copper Clad Steel Co.
Standard Underground Cable Co.
Enamel
Belden Mfg. Co.
Dudlo Mfg. Co.
Maring Wire Co.
Rome Wire Co.
Magnet
American Brass Co.
American Enameled Magnet Wire Co.
Belden Mfg. Co.
Dudlo Mfg. Co.
Hazard Mfg. Co.
Maring Wire Co.
Rome Wire Co.
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American Brass Co.
Electrical Alloy Co.
General Electric Co.
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American Brass Co.
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Belden Mfg. Co.
Hazard Mfg. Co.
Illinois Wire & Cable Co.
Indiana Rub. & Ins. Wire Co.
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Roebling's Sons Co., John A.
Rome Wire Co.
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Simplex Wire & Cable Co.
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American Steel & Wire Co.
Trolley
American Brass Co.
Anaconda Copper Mining Co.
Rome Wire Co.
Underground (Cable)
Hazard Mfg. Co.
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Standard Underground Cable Co.

Wireless Apparatus
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Wood Preservatives
Anderson Mfg. Co., A. & J. M.

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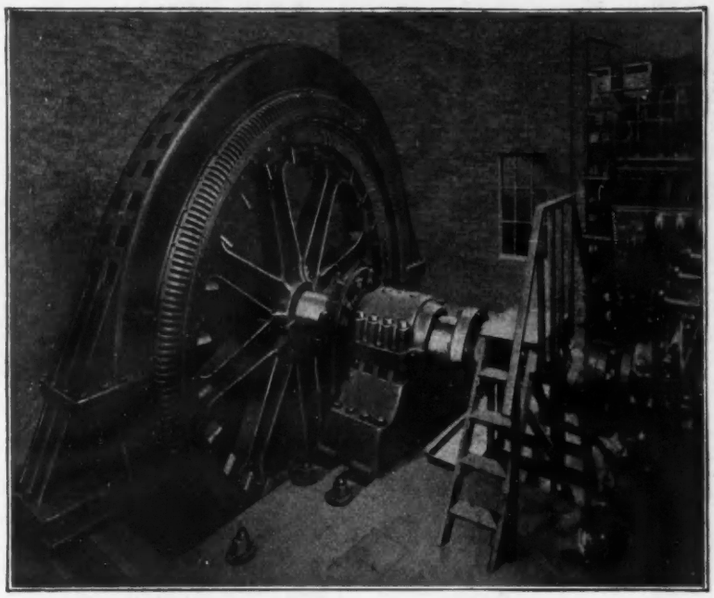

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Condensers
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Hydraulic Turbines
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Metallurgical Machinery
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Flour Mill Machinery
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Air Brakes
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